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Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

Volume 5, Number 3, February 15, 1980

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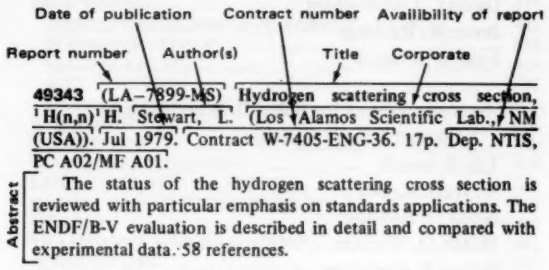
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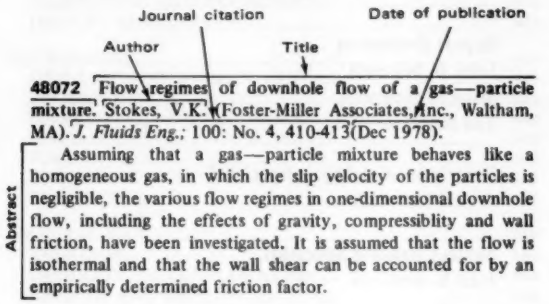
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

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is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Low temperature physics and engineering. Quarterly progress report, January 1–March 31, 1979, 4:48988 (LA–7848-PR)

Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, $^1H(n,n)^1H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
LA-tr-		
78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

3957 **IGT experience in coal utilization.** Chicago, IL; Institute of Gas Technology (1979). 13p. (NP—24022).

Recent work in coal research - that completed in the years 1974-1978 - amounts to more than 30 person-years of professional effort. This work is exclusive of IGT's work on coal gasification but does include projects on coal combustion performed on gasification programs, such as their work on fluidized-bed combustion and effluents. Brief descriptions of recent IGT research programs in the following areas are presented: Technical Feasibility of Coal Usage, Coal Utilization and Combustion, and Coal Properties Research.

PROCESSING

DESULFURIZATION AND PURIFICATION

3958 (BNL—50992) **Regenerative process for desulfurization of high temperature combustion and fuel gases. Quarterly progress report No. 11, October 1-December 31, 1978.** (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 32p. Dep. NTIS, PC A03/MF A01.

In the continuing search for more reactive calcium silicates, Portland cement, as an ingredient of concrete, has been identified to have favorable properties for sulfur absorption and regeneration. Various Portland cements have been studied for their reactivities for sulfation. Most of Portland cements showed equal or higher sorption reactivities than lime. Portland Type III had unusually high activity for a calcium-based sorbent. Furthermore, pellets could be formed from Portland Type III which had high resistance to attrition. Cyclic sulfation and regeneration using Portland Type III have been conducted in a TG system and there was no sign of weakening of the SO_2 sorption activity. The increased reactivity due to increased porosity of Portland cement pellet was noted by the addition of burnable carbon. The effects of both catalysis and porosity can be seen using fly ash as an additive. Sulfation and attrition tests for pellets of limestone fines with various binders have been tested. The results showed that both the strength and the sulfation reactivity were higher for pellets of the limestone fines with colloidal silica binder than for raw limestone. The effects of calcination temperature on the development of pore size and on the SO_2 sorption capacity have been investigated. It has been shown that the temperature maximum observed in a FBC can very possibly be due to pore size variations because of calcinations at different temperatures.

3959 (NTIS/PS—79/0591) **Desulfurization of coal and petroleum. volume 2. 1976-1977 (a bibliography with abstracts). Report for 1976-77.** Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 209p. NTIS PC N01/MF N01.

Research reports on desulfurization of coal and petroleum are cited. Coal preparation, coal liquids, the gasification of coal, and crude oil preparation, where the processes specially accomplish desulfurization before combustion of the fuels are discussed. Coal gasification and coal liquefaction are only included if sulfur removal is stressed. Flue gas desulfurization and other post-combustion sulfur control processes are excluded. (This updated bibliography contains 205 abstracts, none of which are new entries to the previous edition.)

3960 (NTIS/PS—79/0592) **Desulfurization of coal and petroleum. Volume 3. 1978-June 1979 (a bibliography with abstracts). Report for 1978-June.** Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 124p. NTIS PC N01/MF N01.

The two part bibliography covers aspects of coal and petroleum fuel desulfurization relating to coal preparation, coal liquids, the gasification of coal, and crude oil preparation, where the processes specifically accomplish desulfurization before combustion of the fuel. Coal liquefaction and gasification are only included if sulfur removal is stressed. Flue gas desulfurization and other post-combustion sulfur control processes are excluded. (This updated bibliography contains 119 abstracts, all of which are new entries to the previous edition.)

HYDROGENATION

3961 **Flash hydrogenation of lignite in an entrained flow reactor.** Beeson, J.L.; Duncan, D.A.; Oberle, R.D. Chicago, IL; Institute of Gas Technology (1979). 11p. (CONF-790917—14).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

From the foregoing it appears that the hydrocarbon liquids obtained from North Dakota lignite are highly oxygenated as they are devolved from the lignite, and are converted to BTX in the vapor phase by reaction with hydrogen. The conversion of oxygenated compounds to BTX exhibits a pressure and temperature dependency very similar to the dealkylation of toluene in the presence of hydrogen described by Silsby and Sawyer. The distribution of feed carbon among products and the composition of the gasoline boiling range liquids are a function of severity of thermal treatment, and appear to be independent of heating rate when heating rates of 150° F/s or higher are used. The pressure dependency of the dehydroxylation reactions would affect reactor operations, particularly at low hydrogen-to-coal feed ratios where the hydrogen partial pressure would be substantially reduced with the release of methane, steam, and other reaction products. At this writing, the experimental work is being extended to the study of the effects of using preheated hydrogen.

GASIFICATION

REFER ALSO TO CITATION(S) 3958, 3979, 3995

3962 (ANL/EMR—4) **Development of an HPLC, GC/MS method for analysis of HYGAS oil samples.** Raphaelian, L.A. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 138p. Dep. NTIS, PC A07/MF A01.

Direct analysis of a HYGAS oil sample by gas chromatography/mass spectrometry (GC/MS) or capillary column GC/MS is difficult for at least two reasons: (1) due to the large number (probably over 400) of compounds present in the mixture, many overlapping peaks occur, resulting in mass spectra that are often confusing, and (2) moderately to highly polar compounds are not easily chromatographable. In Part 1 of this study, high performance liquid chromatographic (HPLC) methods for separating the complex HYGAS oil samples into fractions were investigated. A satisfactory separation of a HYGAS oil sample into seven fractions was achieved on a μBondapak CN column with a complex gradient of hexane to THF. In Part 2, derivatization as a means for making polar compounds more amenable to identification by capillary column GC/MS was explored. With the use of standard phenols, carboxylic acids, amines, and alcohols. it was found that BSA (a silylating agent) was most effective in derivatizing phenols and alcohols and Methyl-8 Concentrate (an alkylating agent) was most effective in derivatizing carboxylic acids and amines. In Part 3, a preliminary study of the methods developed in Parts 1 and 2, namely HPLC separation into fractions and derivatization of the polar fractions, was undertaken on an authentic HYGAS oil sample to determine whether the methods would make the sample more amenable to analysis by capillary column GC/MS. It was found that, with HPLC, the complex mixtures of HYGAS oil samples are separated into simpler complex mixtures and, with derivatization of the polar fractions, the identifi-

cation by capillary column GC/MS of polar compounds not normally chromatographable was enhanced.

3963 Cost minimization of the process design of the HYGAS reactor. Goyal, A.; Patel, J.G.; Fleming, D.K. Chicago, IL; Institute of Gas Technology (1979). 20p. (CONF-790822—15).

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

An economic analysis was performed for the process design of the HYGAS reactor for a commercial-sized coal gasification plant. Costs were developed for major factors (coal, steam, oxygen, etc.) that can be affected by the selection of the gasifier operating point. These costs were then incorporated into the IGT model for gasifier design. A parametric cost study was then made of the gasifier operating variables. A specific process design for the gasifier was selected, based on the cost minimization study and operational limitations. The projected operating curves for the gasifier were then developed for a range of operating variables.

3964 (CONF-781231—, pp 407-413) **Duplex steam reformer development.** Pflasterer, G.R.; Allen, D.C. (General Electric Co., Sunnyvale, CA). 1979.

From 3. annual thermal energy storage contractor's information exchange meeting; Springfield, VA, USA (5 Dec 1978).

The steam reforming process, which is an established technology, when combined with a high temperature gas-cooled reactor provides the opportunity to apply nuclear heat to industrial processes. The heat from the nuclear reactor can be transmitted chemically by the chemical heat pipe system under study at General Electric. Industrial processes that follow from the development of this concept are: hydrogasification, reduction of iron ore, ammonia synthesis, methanol synthesis, hydrocracking, chemical heat pipe, hydrogeneration of coal, Fischer-Tropsch synthesis, and oxosynthesis. Recognizing the potential advantages of the duplex tube, General Electric proposed a program for its development. And in 1975 ERDA awarded this contract to General Electric Company to begin work. The duplex steam reformer program is divided into four sequential phases which are described briefly.

3965 (COO—4717-3) **Catalytic conversion of oxygenated compounds to low molecular weight olefins. Progress report, January 1-July 31, 1979.** Anthony, R.G. (Texas A and M Univ., College Station (USA). Dept. of Chemical Engineering). 31 Jul 1979. Contract EW-78-5-02-4717. 16p. Dep. NTIS, PC A02/MF A01.

An attractive route for producing ethylene and propylene from coal is to gasify the coal to produce synthesis gas, convert the synthesis gas to methanol, and then convert methanol to the olefins. During this report period the reactions of methanol over chabazite ion exchanged with rare earth chlorides have been studied at reciprocal liquid hourly space velocities of 1.5 to 15, at temperatures of 259, 271, 304, 352, and 427°C, and at pressure 2.7 atm. At 259 and 271°C the principle product was dimethyl ether. As the temperature was increased the conversion of methanol to olefins and alkanes increased to 54% and 32%, respectively. A mixture of dimethyl ether, water, and methanol was fed to the Berty reactor. This mixture was near the equilibrium concentrations for converting pure methanol to dimethyl ether and water at 275°C. The Berty reactor temperature was 427°C. Initially the yields were similar to those obtained when feeding pure methanol. However, the catalyst activity decreased at a faster rate. Rate models are being developed to correlate the catalyst activity and rate as a function of time on stream and partial pressures. A promising model is presented.

3966 (NTIS/PS—79/0374) **Coal gasification and liquefaction technology, volume 3. June 1976-April, 1978 (a bibliography with abstracts). Report for Jun 76-Apr 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 284p. NTIS PC N01/MF N01.

Techniques and processes for the conversion of coal to gaseous and liquid chemicals are cited in this bibliography. It also includes solvent refined coal liquids and coal derived fuels. Coal desulfurization, cleaning, or preparation which does not involve conversion to gas or liquid fuels, or in situ combustion (underground gasification of coal deposits), are not covered. (This updated bibliography contains 277 abstracts, none of which are new entries to the previous edition.)

3967 (NTIS/PS—79/0376) **Coal gasification technology (a bibliography with abstracts). Report for May 78-Mar 79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 198p. NTIS PC N01/MF N01.

Research reports on coal gasification are cited. They cover the techniques and processes of the conversion of coal to chemicals or fuels. Coal desulfurization, cleaning, or preparation, which do not involve conversion to gaseous fuels or chemicals, are not covered. Also excluded are in-situ gasification studies. (This updated bibliography contains 191 abstracts.)

3968 (NTIS/PS—79/0452) **Coal gasification technology (citations from the American Petroleum Institute Data Base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 180p. NTIS PC N01/MF N01.

This bibliography contains citations pertaining to different aspects of coal gasification processes. They cover the design, equipment used, performance, and cost analysis. Coal desulfurization, cleaning, or preparation, which do not involve conversion to fuels or chemicals, are not covered. (Contains 174 abstracts)

3969 Environmental quality and energy conservation in coal conversion processes. Anderson, G.L.; Hill, A.H.; Fleming, D.K. Chicago, IL; Institute of Gas Technology (1979). 9p. (CONF-790571—5). The Publisher, 3424 S. State St., Chicago, IL 60616.

From 6. national conference on energy and the environment; Pittsburgh, PA, USA (21 May 1979).

In general, controlling emissions from a coal conversion process is an energy consuming process. In this paper, a parametric assessment of energy requirements for sulfur management in a coal gasification process to produce substitute natural gas is presented. The results of this assessment suggest that the least energy intensive sulfur management practice to utilize in coal gasification plants using low sulfur coal ($< 3.5\%$) is an H_2S selective removal process providing a Claus plant feed-stream containing 10% or less H_2S with tail gas from the Claus plant being incinerated in the coal-fired boiler and the additional SO_2 removed in the flue gas desulfurization (FGD) system. For high sulfur coals ($> 3.5\%$), energy consumptions for all combinations were similar for a given FGD SO_2 removal specification. As the SO_2 specification increases for the FGD system, the total energy required for sulfur management also increases. Finally, contrary to expectations, the total energy requirements for sulfur management decrease with increasing sulfur content of the feed coal indicating that the energy requiements of the H_2S removal process dominates. The total energy requirements for the two Claus plant tail gas treatment processes are similar. Incineration in the boiler is slightly more energy efficient. For low sulfur coals ($< 3.5\%$) the total energy requirements decreased rapidly as the level of H_2S selective acid-gas removal process decreased from 30% to 10%. For high sulfur coals ($> 3.5\%$) the total energy requirements were similar for all levels of H_2S in the Claus plant feed gas with a possible minimum in energy requirements for the 15% H_2S cases.

3970 Environmental characterization of the HYGAS Process. Anastasia, L.J.; Jonardi, R.J.; Karst, R.H.; Bossart, S.J. Chicago, IL; Institute of Gas Technology (1979). 9p. (CONF-790571—6). The Publisher, 3424 S. State St., Chicago, IL 60616.

From 6. national conference on energy and the environment; Pittsburgh, PA, USA (21 May 1979).

Process streams from the HYGAS Pilot Plant have been systematically sampled and analyzed to obtain experimental data necessary to estimate the formation and fate of environmental species of interest in large demonstration- and commercial-scale HYGAS coal gasification plants. The HYGAS Pilot Plant uses a coal-oil slurry feeding system and operates at coal feed rates up to 3 tons/hr. The pilot plant units of interest include the pretreater and gasifier reactors which are considered scalable to the larger plants. The areas of interest reported here include water-soluble components, oil-soluble components, minor and trace element distributions, and gaseous non-methane hydrocarbon formation.

3971 Predictions of the disposition of select trace constituents in coal gasification processes. Anderson, G.L.; Hill, A.H.; Fleming, D.K. Chicago, IL; Institute of Gas Technology (1979). 44p. (CONF-790449—2(Rev.)). The Publisher, 3424 S. State St., Chicago, IL 60616.

From EPA fuel conversion symposium; Hollywood, FL, USA (17 Apr 1979).

Many factors may affect the formation and disposition of minor and trace constituents in coal gasification processes, e.g., the coal feedstock, the gasification conditions, and the gas processing conditions. Adequate knowledge of the forms and amounts of these constituents and the controlling factors which dictate their final disposition would be desirable for the complete design of a full scale plant. However, the current data base is weak for some of the more volatile inorganic trace constituents that may be gasified with the coal. In this paper, theoretical projections are made on the amount and final disposition during coal gasification of volatile trace constituents formed from arsenic, boron, lead, selenium, and mercury present in coals. Note that these predictions are theoretical; they are intended to provide insight into what might occur in coal gasification processes, to provide direction for future experimental work for improving the data base on these constituents, and to indicate areas where further investigations would prove useful for the design of full scale processes. The results of these studies indicate that high recoveries of these trace inorganics are to be expected, with low discharge to the environment, in most coal gasification process designs.

3972 Utilization potential in industry for low-Btu gases from coal. Waibel, R.T. Chicago, Il; Institute of Gas Technology (1979). 21p. (NP—24139).

Medium-Btu fuel gases from oxygen-blown coal gasifiers can be retrofit on many natural gas industrial burners and produce stable flames with good thermal performance. Low-Btu fuel gases from air-blown gasifiers exhibit more flame stability problems when retrofit to natural gas industrial burners and often give reduced thermal performance. Low- and medium-Btu gases often give longer flames than natural gas. The exact change in flame length depends on the exact burner design. Using low- or medium-Btu fuel gases directly from the gasifier without cleaning to avoid loss of the sensible heat can produce NO/sub x/ and SO/sub x/ emissions much higher than those for the cleaned fuels or natural gas.

3973 IGT U-GAS pilot plant developments. Vora, M.K.; Patel, J.G.; Sandstrom, W.A.; Rehmat, A.G. Chicago, IL; Institute of Gas Technology (1979). 7p. (CONF-790803—57).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

At the Institute of Gas Technology (IGT) significant effort has been expended to develop processes to utilize coal on an environmentally acceptable basis, including coal conversion to low- and medium-Btu gas. These grades of gas can readily be utilized in process steam boilers, industrial heat furnaces, as a local substitute for natural gas and/or fuel oil, electricity generation in combined-cycle power plants and as a feedstock for petrochemicals. The U-GAS process combines a single-stage fluidized-bed gasifier with an ash agglomerating mechanism to achieve selective removal of high-ash-bearing material (agglomerates) and high carbon conversions. To date, successful gasification tests have been conducted that achieved carbon gasification efficiencies exceeding 90% with coal and char feeds and ash agglomerates have been produced during test operations conducted with coke breeze, Illinois No. 6 bituminous coal and washed and unwashed Western Kentucky No. 9 bituminous coal. U-GAS process tests are being completed to produce design data at 60 psia (413 kPa) for an Industrial Fuel Gas Demonstration Plant.

3974 Catalytic gasification of lignite chars. Nandi, S.P.; Johnson, J.L. Chicago, IL; Institute of Gas Technology (1979). 15p. (CONF-790917—13).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

For gasification of lignite chars in hydrogen, sodium was more efficient as a catalyst than calcium. The gasification rate of lignite chars containing sodium or calcium remains essentially constant with the increase of total pressure in steam-hydrogen and synthesis gas mixtures. Both calcium and sodium enhance the rate of gasification of lignite chars in steam-hydrogen mixtures, and the effect is proportional to the concentration (g-atom/g-atom carbon) of sodium and/or calcium present. The catalytic effect of sodium or calcium depends on the nature of char on which the catalyst is dispersed; that is, the same concentration of sodium does not produce the same quantitative effect on rate for chars obtained from lignites having similar elemental composition. The catalysts tend to selectively enhance the rate of the steam-carbon reaction, preferring the carbon-hydrogen reaction when gasification is conducted in steam-hydrogen mixtures.

3975 (LIB-tr—4741) **New attempts at the underground gasification of coal.** Franke, F.H.; Beckervordersandforth, C.P. Translated from *Glueckauf*: **114**: No. 6, 246-251(1978). 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The first objective of the joint Belgian-German project after intensive laboratory work will be to carry out full-scale industrial linking as well as pressure and pressure-alternation in-situ gasification experiments in Belgium. To begin with, boreholes will be sunk from the surface to the coal seam using hydraulic pressure followed by compressed air to expel the water. Then, using the backwards-burning technique, a channel will be formed to link the boreholes together, and so enable the gasification to commence. In these full-scale experiments, the coal will be used in-situ with air to yield a low-Btu gas for the generation of electricity. The first experiments with air will be followed by gasification experiments using oxygen. The object of these studies is basically threefold, to investigate: (1) gasification in deposits which, because of their structural conditions and depth, would be too costly to mine by conventional techniques; (2) gasification first under static, and then under alternating pressure; and (3) the application of, first, air, then oxygen with steam and, finally, hydrogen as gasifying reagents, the switching from one to the next to be determined by the market requirements, which means in the present context the relation between energy demand and price.

3976 (LIB-tr—4828) **Economic prospects for high pressure underground gasification.** Translated from *Ann. Mines Belg.;* No. 2, 139-177(Feb 1977). 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Our economic evaluation based on prices as at August 1975 assumed that the experiments to be carried out in situ would be successful on the technical plane. These experiments are designed to confirm: feasibility of setting up a high pressure underground generator; feasibility of linkage to deep boreholes 70 to 80 m away; and feasibility of achieving sufficiently high gasification efficiency and yield from boreholes which are laid out with appreciable separation, because of the favourable effects of pressure variation and high gasification pressures. Our study confirmed that the cost of the boreholes has a dominant effect on the cost of deep underground gasification. It depends on the depth of the bed, the thickness of the cap-rock and the borehole diameter. Given the size of the cooling devices envisaged inside the gas collector holes, the outer diameter of the collector holes was fixed at 8 5/8" (219 mm), which guarantees electric energy production of 5 MW per borehole for an injected air pressure of not more than 40 bars. Following the Russian practice, borehole specialisation was envisaged, the number of gas collector holes being cut down to 1 out of 2 (in variant 1) or 1 out of 3 (in variant 2). This specialisation offers significant savings in drilling as the diameter of the air injection holes can be smaller. Furthermore, the incidence of the borehole cost on the cost per extracted gigacalorie is inversely proportional to the volume of coal gasified. If 7,000 m3 of coal is gasified per borehole, the cost per extracted gigacalorie at 1,000 m depth could lie between BFr. 180 and 250. This compares favourably with the current price of imported coal and is well below the cost of Belgian coal.

3977 (LIB-tr—4717) **New possibilities of underground in-situ gasification of coal by the pressure alternation processs and the use of nuclear reactor heat.** Wenzel, W.; Franke, F.H.; Meraikib, M. Translated from *Glueckauf-Forschungsh.;* **33**: No. 4, 144-149(1972). 30p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A three-stage cyclical process for the underground gasification of coal is presented which consists first in pumping into the prepared deposit a heated gasifying reagent until a sufficient pressure of gas is attained, secondly in maintaining this pressure to permit conversion and finally in reducing the pressure to collect the conversion product gas. The most suitable reagent is hydrogen as this, unlike oxygen or air, does not react with the exothermically achieved conversion product, methane. The product gas issuing from the deposit is converted to hydrogen and CO on being reacted with steam at a high temperature, the heat being obtained, for example, from nuclear reactors at ground level. After suitable gas purification and conversion, hydrogen is obtained, which when reheated may serve as new gasifying reagent for the next underground gasification cycle. The methane not converted in the reforming plant may, like the hydrogen produced, be transported to the gas consumer.

LIQUEFACTION

REFER ALSO TO CITATION(S) 3962, 3966, 3995

3978 (ANL/CES/TE—79-6) **Coal liquefaction processes.** Baker, N.R.; Blazek, C.F.; Tison, R.R. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 95p. Dep. NTIS, PC A05/MF A01.

Coal liquefaction is an emerging technology receiving great attention as a possible liquid fuel source. Currently, four general methods of converting coal to liquid fuel are under active development: direct hydrogenation; pyrolysis/hydrocarbonization; solvent extraction; and indirect liquefaction. This work is being conducted at the pilot plant stage, usually with a coal feed rate of several tons per day. Several conceptual design studies have been published recently for large (measured in tens of thousands of tons per day coal feed rate) commercial liquefaction plants, and these reports form the data base for this evaluation. Products from a liquefaction facility depend on the particular method and plant design selected, and these products range from synthetic crude oils up through the lighter hydrocarbon gases, and, in some cases, electricity. Various processes are evaluated with respect to product compositions, thermal efficiency, environmental effects, operating and maintenance requirements, and cost. Because of the large plant capacities of current conceptual designs, it is not clear as to how, and on what scale, coal liquefaction may be considered appropriate as an energy source for Integrated Community Energy Systems (CES). Development work, both currently under way and planned for the future, should help to clarify and quantify the question of applicability.

3979 (EPRI-AF—1161) **Production of methanol from lignite. Final report.** (Wentworth Bros., Inc., Cincinnati, OH (USA); Braun (C.F.) and Co., Alhambra, CA (USA)). Sep 1979. 164p. Dep. NTIS, PC A08/MF A01.

Methyl fuel is a high grade liquid fuel ideally suited for electric power generation in steam boilers, gas turbines, and the forthcoming fuel cells. Further it can be readily converted to gas of pipeline quality (SNG) for peaking requirements. It can be transported and stored at low cost. Environmentally its combustion properties

are superior to all hydrocarbon fuels including natural gas. Using technology which is known and proven today, Wentworth Brothers Incorporated has been commissioned by the participants previously listed to conduct a study utilizing an efficient integrated process design for a plant to produce clean-burning Methyl Fuel, by utilizing lignite from the mines of North Dakota. The plant is designed to produce 25,000 tons per day of Methyl Fuel (base case), equivalent to approximately 500 billion Btu per day, HHV (gross heating value). The plant will consume 43,768 tons of lignite (dry basis) per day. It also will produce 538 tons of sulfur per day. The plant is self-sufficient in steam, power and water requirements and in addition generates 176,110 KWH/Hr of electricity for export. The total capital investment is estimated to be 2,399 million dollars (First Quarter, 1978) for the plant producing 25,000 tons per day of Methyl Fuel. The capital investment includes the total plant investment, interest during construction and the working capital. The price of Methyl Fuel, FOB plant in First Quarter, 1978 dollars is estimated to be 3.58 dollars/million ($/MM) Btu HHV @ 12.0% discounted cash flow return on equity.

3980 (FE—3177-3) **Methanol and methyl fuel catalysts. Quarterly report, March-May 1979.** Klier, K.; Herman, R.G. (Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research). Jun 1979. Contract ET-78-S-01-3177. 14p. Dep. NTIS, PC A02/MF A01.

Additional preparations of CuO/ZnO catalysts have been made, and the materials have been examined by x-ray powder diffraction. A series of cerium(IV) containing catalysts have been prepared, and it was shown that the $CuO/ZnO/CeO_2$ = 25/65/10 wt % catalyst precursor contained the copper in the form of $(Cu,Zn)_5(OH)_6CO_3$, analogous to the binary Cu/Zn = 30/70 sample. Calcination of this material, as well as of a binary ZnO/CeO_2 = 87/13 sample, yielded oxides having small crystallite sizes (< 135 A). The reduced binary Cu/Zn catalysts were examined by diffuse reflectance spectroscopy and by x-ray powder diffraction. It was observed that the amount of noncrystalline copper assayed by x-ray diffraction correlated well with that found dissolved in the zinc oxide phase by an earlier scanning transmission electron microscopy study. The relationship between the optical parameters, such as the emergence of the high intensity visible absorption and the loss of the fundamental absorption edge of the zinc oxide, and the existence of the copper-zinc oxide solid solution were established. These results further demonstrate that those catalysts in which the amount of copper dissolved in the zinc oxide is at a maximum are the most active for methanol synthesis.

3981 (NTIS/PS—79/0375) **Coal liquefaction technology (a bibliography with abstracts). Report for May 78-79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 129p. NTIS PC N01/MF N01.

This updated bibliography contains citations on the techniques and processes for the conversion of coal to liquid chemicals or fuels. They cover most aspects of the processes including design, performance evaluation, cost analysis, and plant equipment. Coal desulfurization, cleaning, or preparation, which do not involve conversion to liquid fuels or chemicals, are not covered. (This updated bibliography contains 122 abstracts.)

3982 (NTIS/PS—79/0489) **Coal liquefaction technology (citations from the American Petroleum Institute Data Base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 193p. NTIS PC N01/MF N01.

Techniques and processes for the conversion of coal to liquid chemicals and fuels are cited in this bibliography covering worldwide literature. Included are studies covering in-situ combustion, process equipment, design, and performance. Coal desulfurization, cleaning, or preparation which does not directly involve the liquefaction process are not covered. (Contains 188 abstracts)

3983 **Separation and characterization of Synthoil asphaltene by gel-permeation chromatography and proton nuclear magnetic resonance spectrometry.** Schwager, I.; Kwan, J.T.; Lee, W.C.; Meng, S.; Yen, T.F. (Univ. of Southern California, Los Angeles). Contract EX-76-C-01-2031. *Anal. Chem.;* **51**: No. 11, 1803-1806(Sep 1979).

Synthoil has been fractionated on a preparative scale by gel-permeation chromatography on styrene-divinyl benzene packing (Bio-Beads S-X8). Five fractions were eluted in the order of high to low molecular weights: 3.2 +- 1.0 wt %, anti M/sub n/ = 1280; 31.6 +- 1.7 wt %, anti M/sub n/ = 964 +- 3; 32 +- 2.1 wt %, anti M/sub n/ = 515 +- 12; 20.5 +- 1.1 wt %, anti M/sub n/ = 413 +- 4; 12.7 +- 1.8 wt %, anti M/sub n/ = 359 +- 11. Aromatic molecules with large saturated substituents elute before smaller, more aromatic molecules. Structural characterization of the fractions was carried out using a modified Brown-Ladner proton nuclear magnetic resonance analysis. A plot of molecular weight vs elution volumes for standards, and Synthoil coal liquid fractions affords a relatively smooth curve which may be used to determine approximate molecular weights of coal liquid products. 3 figures, 2 tables.

3984 **Analysis of coal liquids by mass-analyzed ion kinetic energy spectrometry.** Zakett, D.; Shaddock, V.M.; Cooks, R.G. (Purdue Univ., West Lafayette, IN). Contract ET-78-G-01-3377. *Anal. Chem.;* **51**: No. 11, 1849-1852(Sep 1979).

Particular nitrogen-containing compounds, in some cases individual isomers, can be identified in coal liquid samples by mass-analyzed ion kinetic energy spectrometry (MIKES). This is done directly, without prior treatment or fractionation of the sample. Isobutane chemical ionization (CI) is employed to give an approximate molecular weight profile of the coal liquid. Nitrogen-containing ions are recognized by their enhanced tendency for charge stripping as evident in E/2 mass spectra or by using ammonia as the CI reagent. In selected cases, comparison with authentic compounds has been used to verify the MIKES identifications.

3985 **Coal conversion through Riser Cracking.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. Chicago, IL; Institute of Gas Technology (1979). 23p. (CONF-790598—4). The Publisher, 3424 S. State St, Chicago, IL 60616.

From Institute of gas technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Research and development of short residence time hydropyrolysis has involved a bench-scale unit with a high degree of temperature profile control to generate parametric data. Temperatures of 1300° to 1500°F and operating pressures of 500 to 2000 psi have been used to process coals at residence times of 2 to 8 seconds at hydrogen/coal weight ratios of 0.1:2.0. Oil yields of 13% to 15% of feed carbon have been obtained from North Dakota lignite at approximately 50% carbon conversion; oil yields of about 18% of feed carbon have been obtained under similar conditions from bituminous coals. About half of the liquids are in the C_5 to 400°F boiling range and are mostly monoaromatic. In processing, heavy tars are not produced, and the char is a free-flowing dry solid. A process development unit is a small-scale prototype of the reaction system of the IGT commercial concept called Riser Cracking of Coal. The entrained flow riser section will be capable of processing as much as 100 lb/hr of coal. Reaction heat will be supplied by two stages of oxygen combustion within the riser. The PDU operating range can be extended from the liquefaction mode (1500°F, 2000 psig) to a gasification mode (1800°F, 2000 psig) through the use of unique construction features. The prospects for this type of processing continue to look promising. A high degree of flexibility in the oils composition with varying reactor temperature profile (holding the same reactor outlet temperature) has been demonstrated, and the product spectrum itself (methane, ethane, gasoline, and fuel oil) is both valuable and needed. The potential stumbling blocks are the cost of making and recycling hydrogen in the process, achieving extended operation with bituminous coals, and the institutional problems inherent in the multiproduct yields.

PYROLYSIS AND CRACKING

3986 (BNL—50983) **Environmental control technology for the flash hydropyrolysis of coal. Progress report No. 3, April 1-December 31, 1978.** (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 81p. Dep. NTIS, PC A05/MF A01.

Based on experimental results and analytical studies, preliminary environmental and economic assessments of a conceptual, industrial scale FHP-Refinery Complex have been made. Three cases were considered, one for the production of pipeline gas, the second for the production of liquid hydrocarbons such as motor gasoline and LPG, and the third for the production of both liquid and gaseous products. Solid, liquid and gaseous effluents for each case have been evaluated, and required effluent treatment facilities and potential problem areas identified. Thermal efficiencies and investment costs have also been estimated. Net thermal efficiency ranges from 50% to 72%, depending upon the mode of operation of the Complex, and investment costs from 834 to 936 million dollars. The installed cost of environmental equipment is estimated at about 5% of total plant investment for all three cases.

BY-PRODUCTS

3987 (NTIS/PS—79/0405) **Coal tar technology (a bibliography with abstracts). Report for 1964-April 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 172p. NTIS PC N01/MF N01.

The bibliography covers different aspects of coal tar. The citations include coal tar production from coal gasification, synthesis of chemicals from coal tar, toxicology, pollution, chemical analysis, and the use of coal tar as a wood preservative. (This updated bibliography contains 163 abstracts, 25 of which are new entries to the previous edition.)

PROPERTIES

REFER ALSO TO CITATION(S) 4863

3988 (PB—293230) **Internal surface area, moisture content, and porosity of Illinois coals: variations with coal rank.** Thomas, J. Jr; Damberger, H.H. (Illinois State Geological Survey, Urbana (USA)). 1976. 44p. NTIS PC A03/MF A01.

In this report, the authors have discussed methods of measuring the surface area of coal, evaluated the internal surface area of Illinois coals on the basis of their studies, and shown the correlations of internal surface area with such coal rank parameters as calorific value, inherent moisture content, and vitrinite reflectance.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 3958, 4988

3989 (FE—2652-T1) **Prototype anthracite culm combustion boiler/heater unit, City of Wilkes-Barre, Pennsylvania. Quarterly technical report No. 1, October 1-December 31, 1978.** (Wilkes-Barre, City of, PA (USA); Pope, Evans and Robbins, Inc., New York (USA); Foster Wheeler Boiler Corp., Livingston, NJ (USA)). 1978. Contract ET-78-C-01-2652. 23p. Dep. NTIS, PC A02/MF A01.

There are currently about 910 million cubic yards of anthracite culm (mine refuse) contained in 800 separate banks in a 480 square mile area in the Wilkes-Barre (W-B) anthracite mining region. Although this material represents a significant fuel value equivalent to approximately 1.25 billion barrels of fuel oil, the culm banks have been allowed to accumulate because no satisfactory method of combusting this fuel was available until the relatively recent development of the atmospheric fluidized bed (AFB) steam generator. A program was initiated in October 1978 to design, construct and evaluate a 100,000 pph AFB steam generator burning a mixture of anthracite culm and fresh anthracite and demonstrate it to be technically, economically and environmentally feasible to produce 150 psig saturated steam for district heating in downtown W-B. Phase I of the program consists of the design of the boiler and boiler plant and a hot model test program consisting of twenty-one 12-hour batch tests and one 100-hour continuous test to provide a preliminary assessment of anthracite culm as a fuel and to identify commercially acceptable operating conditions for the design of the AFB boiler plant. Phase II of the program consists of construction, operation, testing and evaluation of the boiler and boiler plant.

3990 (NTIS/PS—79/0080) **Coal mine waste (a bibliography with abstracts). Report for 1964-January 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 163p. NTIS PC N01/MF N01.

Research topics cover coal mining refuse, refuse dumps, and spoil. Studies on disposal, utilization, environmental impacts, and testing of these wastes are included, as are reports on land reclamation and spoil bank safety. (This updated bibliography contains 157 abstracts, 19 of which are new entries to the previous edition.)

3991 (PB—292099) **Coal and the environment abstract series. Bibliography on disposal of refuse from coal mines and coal cleaning plants.** Gleason, V.E.; Hill, R.D. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). May 1978. 189p. NTIS PC A09/MF A01.

The subjects covered in this bibliography include the analysis and characterization of coal refuse; various methods of handling, storing, and disposing of coal refuse; the environmental problems such as refuse drainage quality and combustion of refuse piles; the control of environmental problems; and the uses for refuse which have been investigated. The coal cleaning process itself is very closely related to the general subject area covered in this bibliography. However, the large number of publications available on coal cleaning have not been included unless they contained information that contributed significantly to the knowledge and understanding of coal refuse and its related disposal problems. In addition to the abstracts, this volume includes an Author Index and a General Index, described in the section 'The Bibliography, Its Format and Use' beginning on page 103, and an update for each of the environmental bibliographies described above. Appendix I, 'Coal and the Environment Abstract Series: Bibliography on Mined-Land Reclamation' lists on page 141 publications acquired by BCR since 1975. Appendix II 'Coal and the Environment Abstract Series: Mine Drainage Bibliography,' lists on page 169 publications acquired since 1976.

3992 (PB—293210) **Fuel contaminants. Volume 4. Application of oil agglomeration to coal wastes. Final report, August 1977-April 1978.** Mezey, E.J.; Min, S.; Folsom, D. (Battelle Columbus Labs., OH (USA)). Jan 1979. Contract EPA-68-02-2112. 95p. NTIS PC A05/MF A01.

The report gives results of a study of the application of oil agglomeration to coal wastes. There are an estimated 3000-5000 sizeable active and abandoned coal waste piles and impoundments in the eastern U.S. coal fields alone, containing 3 billion tons of refuse, part of which are slurry ponds. The impoundments, containing coal fines from coal preparation/cleaning plants, are a ready reserve of mined fuel for use in times of shortages. It appears that oil agglomeration could contribute significantly to the removal of contaminants before the conversion process is undertaken. The ability of agglomeration to dewater finely ground wet coal also suggests further incorporation of the process in any environmentally sound preparation plant supplying these conversion plants. Early studies indicated that, although agglomeration can effectively remove much of the ash forming minerals, it was unable to separate the liberated pyrite from coal. This program was undertaken to investigate several approaches, identified during the first phase, to enhance pyrite removal during agglomeration and to demonstrate the utility of the technology to reduce the environmental impact of increased quantities of coal cleaning refuse. Study results show that the coal recovered is of better quality than the coal now being shipped from the mine, in that sulfur and ash values are lower. Coal value recoveries were greater than 90%.

3993 (PB—293278) **Environmental assessment of coke by-product recovery plants. Final report March 1977-June 1978.** VanOsdell, D.W.; Marsland, D.; Carpenter, B.H.; Sparacino, C.; Jablin, R. (Research Triangle Inst., Durham, NC (USA)). Jan 1979. Contract EPA-68-02-2630. 389p. NTIS PC A17/MF A01.

The report gives results of an initial screening study, initiating a multimedia environmental assessment of coke by-product recovery plants in the U.S. The study included both the gathering and analysis of existing data and sampling and analysis at one plant based on EPA's Industrial Environmental Research Laboratory-RTP Level 1 protocol. Process data concerning design and operation of existing plants and processes were examined. Many variations of all processes types exist, forcing an examination of the industry to determine the commoner processes. Sampling and analysis utilized a basic EPA Level 1 format, tailored for organic vapor sampling. Specific samples were also analyzed for cyanide. Air was sampled at all suspected pollution sources, most of them storage tanks. The largest single source was the final cooler cooling tower: aromatics at greater than 50 g/Mg coke and cyanide at 278 g/Mg coke were both significant. Polynuclear aromatic hydrocarbon (PAH) compounds were indicated, but not quantified. Concentrations of pollutants in the vapor above storage tanks were measured, but actual emission rates were not determined because of the difficulty in measuring working and breathing losses for the tanks sampled. Water sampling data from the same plant, developed by EPA's Effluent Guidelines Division, were included in the overall study analysis.

3994 (PB—293328) **Fuel contaminants. Volume 3. Control of coal-related pollutants. Final report, July 1975-July 1976.** Mezey, E.J.; Min, S.; Allen, B.R.; Baytos, W.C.; Singh, S. (Battelle Columbus Labs., OH (USA)). Jan 1979. Contract EPA-68-02-2112. 135p. NTIS PC A07/MF A01.

The report gives results of a study to identify strategies for removing pollutants from coal and coal-derived liquids. Of the approaches considered, five were selected for preliminary assessment by experimentation (a sixth, improvements in pyrite liberation from coal, was not studied because of significant advances by others). Study findings include: (1) biological action on coal-derived liquids--prospects of using nonmutated bacteria for sulfur and/or nitrogen removal from coal liquids appear small; (2) enhancement of pyrite removal during immiscible fluid agglomeration--removal equivalent to that obtained for float-sink analysis was obtained by pretreatment and oil agglomeration, the same technique found to be effective for recovering greater than 90% of coal from coal cleaning plant fines; (3) extraction of clean fuels from coal liquids--light hydrocarbons can be used to extract 83% of coal liquid at supercritical conditions to yield a low sulfur and nitrogen fuel; (4) concentration of organic sulfur and nitrogen and ash from coal liquids--up to 76% of the sulfur and about 10% of the nitrogen can be removed by passing coal liquids over various special porous media; and (5) conversion of coal liquefaction residues to environmentally acceptable fuels--treatment of coal liquefaction residue with H2/CO mixtures reduces nitrogen content by as much as 14%.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 3970, 3986, 3987, 3990

3995 (NTIS/PS—79/0378/SL) **Pollution and environmental aspects of fuel conversion (a bibliography with abstracts). Report for 1964-March 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1979. 278p. NTIS PC N01/MF N01.

Abstracts dealing with environmental impacts related to fossil fuel conversion processes (primarily coal gasification) are presented. A few citations concerning environmental considerations pertaining to future energy growth are included. (This updated bibliography contains 271 abstracts, 58 of which are new entries to the previous edition.)

3996 (NTIS/PS—79/0380) **Coke oven air and water pollution (citations from the Engineering Index data base). Report for 1970-March 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1979. 191p. NTIS PC N01/MF N01.

Monitoring, sampling, analyzing, transport properties, and control of emissions and effluents are cited in this compilation from worldwide journals. Pollutants described are sulfur dioxide, hydrogen sulfide, ammonia, phenols, benzopyrene, particulates and other trace elements and compounds. Process and equipment modifications, such as pipeline charging, wet and dry quenching, retrofitting, and oven leakage preventives are included. (This updated bibliography contains 185 abstracts, 15 of which are new entries to the previous edition.)

3997 (PB—293225) **Preliminary environmental assessment of the lignite-fired CAFB. Final report January 1977-October 1978.** Werner, A.S.; Young, C.W.; Piispanen, W.; Myatt, B.M. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Feb 1979. Contract EPA-68-02-2632. 257p. NTIS PC A12/MF A01.

The report gives results of a preliminary environmental assessment (EA) of the lignite-fired Chemically Active Fluid-Bed (CAFB) process. It follows an earlier EA of the oil-fired CAFB. Waste streams contributing air and solid waste pollutants were evaluated in terms of emission rates and potential environmental effects. Emphasis is placed on flue gas emissions. As part of the investigation, a field sampling and laboratory analysis program was carried out to compile an emissions inventory of the CAFB pilot plant at the Esso Research Centre in Abingdon, England. In addition to the EA, an economic evaluation of the oil-fired CAFB is presented relative to alternative residual oil utilization techniques. Finally, recommendations are made for further control needs and emissions testing to be carried out in conjunction with the CAFB demonstration plant in San Benito, Texas. Particulate emissions were less than those from direct combustion of lignite using multiclones as a control. NOx emissions were quite low: 0.09 lb/million Btu was the highest measured. Light organics were equal to those from conventional units; heavy (> C6) emissions were lower. SOx emissions were half the New Source Performance Standard for coal-fired boilers.

RESERVES AND EXPLORATION

3998 (NCSEI—0001) **Geophysical exploration of coal and gas resources associated with a buried Triassic basin in the NC coastal plains. Final report.** Won, I.J.; Leith, C.J. (North Carolina State Univ., Raleigh (USA). Dept. of Geosciences). 1 Oct 1979. 17p. NTIS, PC A02/MF A01.

We have conducted a comprehensive field geophysical study in an area including Lenoir, Jones, and Craven counties in the coastal plains of North Carolina in order to determine the subsurface geological features and favorability of any hydrocarbon occurrence thereof. The study employed an integrated approach using gravity, aeromagnetic, and electrical sounding methods combined with three shallow test holes drilled by the State of North Carolina during the study. The results obtained from the study thus far are negative: the Graingers Basin originally suggested from the aeromagnetic data is now believed to be of Paleozoic age rather than the initially assumed Triassic age. The basement structure, originally inferred from gravity data, is re-interpreted to match the top of phyllite in the light of drill hole data. Although our electrical sounding data in the area suggest that the crystalline basement is much deeper than the phyllite basement, the intervening formations are most likely of metamorphosed Paleozoic sediments similar to the slate-belt type rocks, having little chance of containing any hydrocarbon materials. The study has revealed another possibly more promising basin structure between New Bern and Havelock. The data thus far show that the basin, if any, may be much deeper than the Graingers basin. The detailed structure of this basin is yet to be investigated.

3999 **Wyoming coal fields, 1978.** Glass, G.B. Laramie, WY; Geological Survey of Wyoming (1978). 98p. (NP—24078).

When an estimate of the resources of the previously omitted 53.46% of the State's coal-bearing land is added to the mapped and explored estimate, the US Geological Survey estimates that Wyoming's original resources under less than 3,000 ft of overburden increase to 836,891,430,000 tons. Wyoming's original resource figure becomes 936,891,430,000 tons when the overburden category is extended to 6000 ft (Averitt, 1975). In the 0 to 6,000 ft overburden category, Wyoming has the largest in-place coal resources in the nation. Estimates of Wyoming's original in-place coal resources by major coal-bearing region and by county are given in Tables. The original resources in these tables include mapped and explored bituminous coals 14 in. or greater in thickness and subbituminous coals 2.5 ft and thicker. Measured, indicated, and inferred categories are combined; overburden limits for these figures are 0 to 3000 ft. Coal production is reported by county. Wyoming's coal reserve base is also shown as approximately 56 billion tons. Wyoming's known strippable reserve base of subbituminous coal is shown in Table 9. This strippable reserve base is limited to a few mapped and explored areas and is only a small portion of Wyoming's potentially strippable coal, which could easily total ten times the known reserve base.

4000 **Coal analyses and lithologic descriptions of five core holes drilled in the Carbon Basin of southcentral Wyoming.** Glass, G.B. Laramie, WY; Geological Survey of Wyoming (1978). 105p. (NP—24147).

The Geological Survey of Wyoming conducted a drilling project in the Carbon Basin of southcentral Wyoming. In all, 2454.9 feet of 1-3/4-inch to 2-inch diameter cores were recovered from a total of five core holes. Another two holes were rotary-air drilled for later use as monitor water wells. Lithologic descriptions of the cores and air-drilled cuttings were made in the laboratory during the winter of 1977 and spring of 1978. Eighteen core samples of coal were described in the field, and then sent to the US Geological Survey's laboratory in Denver for analysis. In turn, the US Geological Survey sent a split of the samples to the US Bureau of Mines. While the US Bureau of Mines performed routine analyses and physical tests on the samples, the US Geological Survey determined concentrations of major, minor, and trace elements. To complement each of the analyses, a detailed megascopic description of each coal sample is provided.

MINING

REFER ALSO TO CITATION(S) 3990, 4842

4001 (DOE/ET/10022—T2) **Development and fabrication of a dragline training system. Technical progress report, No. 1 (phase 1 final report).** (McDonnell Douglas Electronics Co., St. Charles, MO (USA)). 17 Sep 1979. Contract AC01-79ET10022. 98p. Dep. NTIS, PC A05/MF A01.

As a result of the task analysis and revision to the plan of instruction, certain desirable characteristics were recommended to be added to the dragline trainer. These essentially would provide for a high quality feedback and hard copy record of the trainee's performance. It was recommended that the trainer be able to produce and/or sense and record: drag and hoist over-spooling, drag-chain/cone contact, bucket shock, bucket stall, lateral boom stress, tight lining, excessive rapid braking and reaction times to internal/external alarms. In addition, data such as cycle time, bucket position, yardage moved and cycles completed should be recorded and records printed. With the exception of drag chain and cone contact indications, these characteristics can be implemented in the computer program. In some cases, such as bucket stall and external alarms it will require instructor initiative to activate specific trainer scenario and reaction time measurements. It should be noted that these additional features, however desirable, add significantly to the required computer capability. Both processor cycle time and memory availability could be restraints. A faster, and larger system could accommodate these added features but at an increase in cost for the computer system. A study is in process and specific recommendations will result.

4002 (PB—295292) **Design and fabrication of instrumentation for remote sealing of underground coal mine passageways. Volume I. Final technical report.** Monaghan, D.A.; Berry, D.R.; Brunelle, B.C. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jul 1977. Contract H0144004. 78p. NTIS PC A05/MF A01.

This report describes instrumentation that is part of a system for extinguishing mine fires by pumping material through surface boreholes to seal off all underground passageways leading to the fire area. Major instrumentation systems include a closed-circuit television (CCTV) probing system and an acoustic seal checking system. The latter consists of a speaker probe, a receiver probe, and related signal processing equipment. All probes can be winch-deployed down a 6-inch diameter borehole. The CCTV unit can be rotated 360 degrees in the horizontal plane, and contains sufficient lighting to reliably assay conditions for sealing or rescue within a 200-foot radius. The acoustic seal checker monitors the completion of a seal as it progresses by use of probes lowered through boreholes on either side of the seal.

4003 **1977 Division of Mines report with coal and industrial mineral directories of reporting firms.** Stringer, E. Columbus, OH; Ohio Department of Industrial Relations (1977). 129p. (NP--24152).

The 1977 Ohio Division of Mines annual report provides production statistics, employment and wage data and other pertinent information of value to the mining industry, companies desiring to locate in Ohio, and the existing industries planning to expand. Production increased this year in industrial minerals and coal mining, while the value of extracted materials and wages remained about the same. The inclusion of comprehensive statistical data makes the Division's report an invaluable reference for industry. A primary function of the Ohio Industrial Relations Department's Division of Mines centers on the enforcement and supervision of Ohio mining laws. The report concerns the activities of the Division of Mines for the calendar year 1977 with directories of the reporting mining operations.

4004 (PNL-TR—363) **Prospects for full-face heading machines in bituminous coal mining in Germany.** Reuther, E.U.; Haege, K. Translated from *Glueckauf;* **109**: No. 18, 901-907(1973). 28p. Dep. NTIS, PC A03/MF A01.

Full-face heading machines are being used for driving horizontal stone drifts in bituminous coal mining in Germany. Since such driving operations generally do not reach lengths necessary to fully depreciate the machine, the future operation of full-face heading machines depends on the whole on the nature and scope of development work being done in bituminous coal mining. A survey has been carried out of the driving operations along horizontal stone drifts longer than 1 km planned for the next two decades, and the possibility of fully mechanized driving has been examined. Since the roadways surveyed concerned only development work to keep up production capacity, we can assume that the scope of driving operations will be maintained, provided there is no significant decline in production capacity in bituminous coal mining in West Germany. It was found that the cross sections of the planned roadways can be grouped according to diameter, and that a few machine sizes, characterized by different borehole diameters, can be derived from those groups. The projects covered by the survey are ordered such that, for the machines of the same diameter, a sequence of driving operations is established to approximate their expected useful life as closely as possible. Three machines would suffice for the estimated 45 to 65 km required roadways longer than 3 km. However, the suitability of the boring technique for a particular project is a question of the attendant costs and thus of its competitiveness with respect to the conventional blasting technique. This question can be decided only from case to case.

4005 (PNL-TR—359) **Two-stage heading machine for fully mechanized driving of a lateral of 5.3 meters diameter.** Otto, U. Translated from *Glueckauf;* **107**: No. 21, 809-811(1971). 11p. Dep. NTIS, PC A02/MF A01.

Plans exist to drive a lateral of 1.6 km length and 5.3 m diameter as a ventilation road in the 1100-m horizon of the Consolidation Colliery in Gelsenkirchen (owned by Bergbau AG, Essen). The machine to be used is a heading machine manufactured by Maschinen- und Bohrgeraete-Fabrik Alfred Wirth and Co. KG, Erkelenz. Responsibility for driving the roadway has been assumed by a study group consisting of Gesteins- und Tiefbau GmbH, Essen Gebhardt and Koenig-Deutsche Schachtbau GmbH, Essen, and Murer AG, Erstfeld (Switzerland). The Wirth heading machine is 45 m long and weighs 200 tons. It is being used for the first time for bituminous coal mining in Germany. It consists of the TB II - 300 H full-face and pilot boring machine and of the TBE-II - 300/600 expander boring machine.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 4016

4006 (PMTC—6(79)) **Performance characteristics of coal-washing equipment: air tables. Report of investigations.** Killmeyer, R.P. Jr.; Deurbrouck, A.W. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Mining Technology Center). Apr 1979. 35p. Dep. NTIS, PC A03/MF A01.

Four air table tests were conducted in two different preparation plants to determine the performance characteristics that might be anticipated in commercial operation. The air tables provided rough separations at high specific gravities of separation between 1.78 and 2.67; one test was unusually low at 1.56. Air tables are ideally suited to perform a rough black-and-white separation producing a clean coal and a refuse product, or to scalp the heavy impurities and clean coal while retreating the middlings in a subsequent cleaning circuit employing a device which usually produces a sharper separation. Air tables provide an inexpensive method of removing ash and pyrite, but at the cost of poor sharpness of separation. Error area values were above 251 and probable error values were above 0.296. The air table only does an effective cleaning job down to 28 mesh. Virtually all of the feed finer than 28 mesh reports to the clean coal or the dust collection system.

COMBUSTION

REFER ALSO TO CITATION(S) 4474, 4796

4007 (ANL/CEN/FE—78-10) **Support studies in fluidized-bed combustion. Annual report, July 1977-September 1978.** Johnson, I.; Vogel, G.J.; Lee, S.H.D. (Argonne National Lab., IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 115p. Dep. NTIS, PC A06/MF A01.

These laboratory and process development-scale studies support the Fossil Energy development program for atmospheric and pressurized fluidized-bed coal combustion. This report presents information on the enhancement of limestone sulfation by the use of chemical additives, the evaluation of coal char as fuel for FBCs, the use of oil shale in place of limestone for SO_2 emission control, development of a model for the prediction of the performance of limestones in FBCs from laboratory data, studies of the emission of alkali metal compounds from coal combustion systems, development of sorbents for the removal of gaseous KCl and NaCl from hot gas streams, studies of the fate of trace elements in a FBC combustion-regeneration system, evaluation of two laser instruments for the in situ measurement of particle size and concentration in a hot gas stream, evaluation of a high efficiency cyclone, the development of a granular bed filter for particulate removal, the development of a high-intensity sound source to enhance particulate agglomeration, and the development of a pulsed L-valve for the metering of the flow of solids.

4008 **Electric power generation from Texas lignite.** Kaiser, W.R. Austin, TX; University of Texas (1978). 22p. (NP—24163).

Lignite is a rediscovered energy resource in Texas because lignite-produced energy is 3 to 7 times cheaper than intrastate natural gas. Production has risen from 18,000 short tons in 1950 to 14 million tons in 1976 and will exceed 50 million tons by 1985. Currently installed lignite-fired generating capacity is 3410 MW and may reach 11,475 MW in 1985. Steam-electric stations up to 3000 MW are planned; individual generating units are 120 to 750 MW. Statewide resources of strippable lignite are set at 12.2 billion tons. The best grade (average 7100 Btu/lb) and largest deposits (as much as 400 million tons) occur in the Wilcox of East Texas where all operating mines are located. Fouling and slagging of pulverized-coal boilers burning Wilcox lignite has not been an operating problem. However, control of particulate emissions is a problem and is attributed to high ash resistivity. Electrostatic precipitations, baghouses, and gas conditioning are used for particulate control. Wet-limestone throwaway SO_2 control systems are being installed on newer units. Boilers that will burn high-fouling South Texas Jackson lignite are conservatively designed with low-volume heat release (7500 Btu/ft^3-hr), low gas-exit temperature, extra furnace height, wider tube spacing, and numerous soot blowers.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 3976

4009 (DOE/EIA/8606—2(Vol.2)) **Impact of petroleum industry horizontal divestiture on the coal market.** Zimmerman, D.L.; Dymond, L.H.; Marris, R.L. (Synergy, Inc., Washington, DC (USA)). 22 Jun 1979. Contract EM-77-C-01-8606. 215p. Dep. NTIS, PC A10/MF A01.

Volume 2 contains appendices as follows: coal supply curves, coal supply model modifications, coal mine financing data, legislative proposals for horizontal divestiture, overview of oil companies in coal industry (including their coal reserves) and the major sources of data and bibliography. (LTN)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 4002

PETROLEUM

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 4022

4010 **High conformance oil recovery process.** Varnon, J.E.; Kudchadker, M.V.; Brown, A.; Whittington, L.E. (to Texaco Inc.). US Patent 4,159,037. 26 Jun 1979. Filed date 1 May 1978. 16p.

The conformance of an enhanced oil recovery process, including waterflood, surfactant or other chemicalized water flood process, in a formation containing at least two strata or zones of varying permeability, the permeability of one zone being at least 50 percent greater than the permeability of the other zone, is improved by flooding until the higher permeability zone has been depleted, after which an aqueous fluid is injected into the high permeability zone, said fluid having relatively low viscosity at the time of injection and containing a blend of surface active agents which promote the formation of a coarse viscous emulsion in the flow channels of the formation which reduces the permeability of the high permeability zone. After the permeability of the first zone has been reduced substantially, flooding may then be accomplished in the second zone which was originally not invaded by the injected oil recovery fluid. The surface active agents are individually tailored and the ratio of dissimilar surfactants balanced to exhibit optimum viscous emulsion formation properties. The optimum emulsifying surfactant comprises a mixture of an organic sulfonate such as petroleum sulfonate and a solubilizing co-surfactant such as an alkyl or alkylarylpolyalkoxy alkylene sulfonate and/or a low molecular weight alcohol.

4011 (NP—24109) **Investigations for an optimum yield of petroleum deposits.** Boor, G. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 16 May 1977. 147p. (In German). Dep. NTIS (US Sales Only), PC A07/MF A01.

Thesis.

The paper attempts an investigation of effects and interactions of physical, technical, and economic factors with regard to an optimization of petroleum yields. For this purpose, an optimization calculation is carried out for the yield of a model petroleum deposit with the aid of the simulation method.

4012 (SAN—1331-T3) **Summary of air repressurization for enhanced oil recovery. Conseltant report.** Adent, W.A. (California State Lands Div., Long Beach (USA)). Oct 1978. Contract EY-76-C-03-1331. 15p. Dep. NTIS, PC A02/MF A01.

The air injection process (also known as the Smith-Dunn or Marietta Process) is a proven technique for the enhanced recovery of oil. The process has been used successfully in Ohio, West Virginia, Pennsylvania, Kentucky, Illinois, Kansas, Oklahoma and Texas. The process is usually associated with leases of low oil production and nearly exhausted reservoir pressure. The process has been used in California in three wells for a few months duration witn inconclusive results. When using this process, an explosion hazard is present when certain proportions of air-methane gas are reached. Although a literature search and recent correspondence has not revealed any explosion in air injection repressurization projects caused by spontaneous combustion of the air-natural gas mixture, it is believed such explosions are possible and did occur with ignition by electrostatic or chemical conditions.

4013 (SAND—79-1298) **Wellbore heat loss for steam injection into deep reservoirs.** Hickox, C.E. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 55p. Dep. NTIS, PC A04/MF A01.

A numerical method is developed and applied to the analysis of steam injection into typical wellbores. The steam flow is assumed to be one-dimensional with quasi-steady heat transfer occurring only in the radial direction. Numerical simulations are used to assess the relative effects of time of injection, pipe friction, radiation heat transfer, insulation of the injection tube, and geometry changes in the well completion for selected values of surface injection pressure and mass flow rate. Simulations are restricted to those cases for which the steam quality is between zero and one-hundred percent. It is concluded that a typical wellbore can be adequately insulated, using conventional insulation, so that steam of reasonably high energy content can be injected at mass flow rates from 5000 to 15,000 lbm/hr into oil reservoirs as deep as 5000 feet.

4014 **Process for reducing fluid flow to and from a zone adjacent a hydrocarbon producing formation.** Coulter, G.R. (to Halliburton Co.). US Patent 4,157,116. 5 Jun 1979. Filed date 5 Jun 1978. 12p.

A method for reducing fluid flow from and to a subterranean zone contiguous to a hydrocarbon producing formation which includes the steps of initially extending a common fracture horizontally into the zone and into the formation to locate a portion of the fracture in each of the zone and the formation, then introducing a porous bed of solid particles into that portion of the fracture located in the zone. A removable diverting material, such as a gel, is then introduced into the portion of the fracture located in the formation and adjacent the locus of the bed of solid particles to block the portion of the fracture occupied by the diverting material to a selected fluid sealing material. The selected sealing material is then introduced to the interstices of the particles in the porous bed, and is set to a fluid-impermeable seal to impede fluid flow to and from said zone. The diverting material is then removed to facilitate hydrocarbon production from the formation. 23 claims.

4015 **Lignosulfonates as additives in recovery processes involving chemical recovery processes.** Kalfoglou, G. (to Texaco Inc.). US Patent 4,157,115. 5 Jun 1979. Filed date 10 Nov 1977. 16p.

A process for producing petroleum from subterranean formations is disclosed wherein production from the formation is obtained by driving a fluid from an injection well to a production well. The process involves injecting via the injection well into the formation an aqueous solution of lignosulfonate salt as a sacrificial agent to inhibit the deposition of surfactant on the reservoir matrix. The process may best be carried out by injecting the lignosulfonates into the formation through the injection well mixed with a surfactant solution. This mixture would then be followed by a drive fluid such as water to push the chemicals to the production well. The surfactant solution comprises a mixture of petroleum sulfonate and an alkyl benzene alkoxylated sulfonate. In another embodiment, the surfactant solution comprises sulfonated alkoxylated alkyl surfactants and/or alkyl benzene alkoxylated sulfonates. 4 claims.

4016 **Influence of ultrasound on liquid flow through inhomogeneous media.** Fairbanks, H.V. Morgantown, WV; West Virginia University (1978). 7p. (CONF-7809180—1).

From 2. congress of the Federation of Acoustical Societies of Europe; Warsaw, Poland (Sep 1978).

Results of three different investigations are reported. They include: (1) stimulation of flow of crude oil through porous sandstone with the aid of ultrasound, (2) removal of solids from a viscous oil slurry by filtration through a porous stainless steel filter with the aid of ultrasound, and (3) drying of powdered coal with the aid of ultrasound. It was found that the introduction of ultrasound into these different systems could substantially improve the liquid flow through the porous media used. The ultrasonic frequency used was 20 KHz with sound intensities up to 170 dB.

PROCESSING

REFER ALSO TO CITATION(S) 3959, 3960, 3964

4017 **Hydrocracking process to maximize middle distillate.** O'Hara, M.J.; Johnson, R.W.; Hilfman, L. (to UOP Inc.). US Patent 4,157,292. 5 Jun 1979. Filed date 20 Jun 1978. 8p.

Disclosed is a hydrocracking catalyst comprising an alumina-zeolite support, a rare earth exchange metal component, at least one metal component selected from Group VIB or Group VIII and from about 0.9 to about 5 wt % of at least one component selected from Group IA based on the weight of the furnished catalyst. 6 claims.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 4009

4018 (DOE/EIA—0103/21(78-1)) **Petroleum allocation model. Technical memorandum.** Kilgore, W.C. (Department of Energy, Washington, DC (USA). Energy Information Administration). 23 Dec 1977. 19p. Dep. NTIS, PC A02/MF A01.

This paper documents a procedure developed to forecast international trade patterns in crude oil and refined products. This methodology is used to estimate future sources of petroleum imports to the United States and to calculate expected shortfalls in those imports that would result from supply interruptions. The procedure is computerized in the form of a Petroleum Allocation (PAL) model which is operational on the Energy Information Administration computer facility.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 4032, 4930, 4931, 5005, 5009, 5011

4019 (AD-A—065192) **Tundra disturbances and recovery following the 1949 exploratory drilling, Fish Creek, northern Alaska.** Lawson, D.E.; Brown, J.; Everett, K.R.; Johnson, A.W.; Komarkova, V. (Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Dec 1978. 92p. NTIS PC A05/MF A01.

A 1949 drill site in the Naval Petroleum Reserve Number 4, Alaska, the Fish Creek Test Well 1, was examined in August 1977 to determine the disturbance caused by drilling activities and to analyze the response and recovery of vegetation, soils, permafrost, and surficial materials to that disturbance. Man-made disturbances include bladed and unbladed vehicular trails, a winter runway, excavations, pilings, remains of camp structures, steel drums and other solid waste, and hydrocarbon spills. The most intense and lasting disturbance to the vegetation, soils, and permafrost resulted from bulldozing of surface materials, diesel fuel spills, and trails developed by

multiple passes of vehicles. Thermokarst subsidence and thermal erosion, caused by increased thaw of permafrost due to disturbance, resulted in the development of a hummocky topography and water-filled depressions at the drill site. Some ice wedges disturbed in 1949 are still melting. Soil disturbance ranges from minor modification to complete destruction of the soil morphology. The effects of hydrocarbon spills are still detectable in the soils. Little of the original vegetation remains in the intensely disturbed area, such as around the drill pad where a grass-dominated community prevails. After 28 years, the vegetation cover is closed over most mesic sites, shallow wet sites are well vegetated, and xeric sites, areas of diesel fuel spills and areas of severe erosion remain mostly bare. Pioneering plant species on bare, disturbed areas are members of mature vegetation assemblages from the undisturbed tundra which have high reproductive and dispersal capacities. A hypothetical model of natural revegetation and vegetation recovery is proposed.

4020 (AD-A—065455) **Field tests of six offshore oil containment booms. I. Final report.** Corpuz, P.R.; Griffiths, R.A. (Coast Guard, Washington, DC (USA). Office of Research and Development). Nov 1978. 72p. NTIS PC A04/MF A01.

This report describes the test procedures and equipment used in testing six different oil containment booms in the Gulf of Mexico. Oil was not used. Each boom was evaluated for its seakeeping and logistic requirements for deployment and retrieval. Each boom was moored in a U shape, or catenary, configuration. This was done by establishing two sets of mooring buoys on opposite sides of the Navy platform, Stage I, off Panama City, Florida. Test were conducted from 28 March through 28 April 1977. The booms tested were obtained on loan from the various manufacturers, their representatives, or other sources. An attempt was made to obtain booms suitable for open water use that employ different means of maintaining flotation and of carrying tension. Seakeeping data was obtained through documentation with a videotape system developed by the U.S. Coast Guard Research and Development Center. The videotapes were analyzed, and the data are presented in Part 2 of this report.

4021 (AD-A—067363) **Reducing problems of the public in an oil spill: s case study of the Nepco 140 incident, the St. Lawrence River, June, 1976. Final report Aug 77-Apr 78.** Omohundro, J.T. (State Univ. of New York, Albany (USA). Research Foundation). Apr 1978. Contract DOT-CG-71757. 121p. Availability: Microfiche copies only.

The methodology sociologists have developed for natural disaster research is applied to a large pollution event. Questionnaires, interviews, and documentary fieldwork in the riparian communities on the U.S. side of the St. Lawrence River between Mason's Point, Jefferson County, New York, and Massena, St. Lawrence County, New York, provide the data. Conditions before the pollution event are reviewed for their influence on the emergency behavior of citizens. The public's immediate reaction to the spill, their alert and self-protective measures, their search for organization and information, their evaluation of the work of the pollution contractors and Coast Guard, and their evaluation of the effects of the spill are analysed through narrative and simple statistical procedures. The report concludes that the area residents' planning for and response to a massive river pollution even needs improvement and that the Coast Guard's handling of public problems in a pollution event can also be improved. Recommendations are made which could be applicable to Coast Guard public relations and spill planning on the St. Lawrence River as well as other water bodies. (Author)

4022 (PB—294812) **Modeling of stationary air pollution sources in the central and western Kern County oil fields. Task report. volume i: text.** Simmon, P.B.; Ludwig, F.L.; Nitz, K.C. (SRI International, Menlo Park, CA (USA)). Jan 1979. Contract EPA-68-01-4137. 117p. NTIS PC A06/MF A01.

The use of steam injection to recover high viscosity oil in Kern County, California has created the potential for violation of federal and state ambient air quality standards in that area. The increasing number of permit applications for development of new steam generation facilities has prompted the Environmental Protection Agency to commission a study to determine the sulfur dioxide levels produced by the present and proposed configurations of crude oil-fired steam generators. This report presents the results of that study. Two locations in Kern County were of interest: the oil fields in the central portion of the county, near Bakersfield, and the oil fields well to the west of Bakersfield, lying on a roughly NW to SE line about 40 miles in length, between the towns of McKittrick and Maricopa. To assess the air quality at the two locations, data describing the meteorological conditions, the measured SO2 levels, and inventories of both generator and nongenerator sources were collected and reduced. A limited verification of data detailing generator source characteristics, particularly location, was performed.

4023 **End connector for floating oil boom.** Acheson, R. (to Albany International Corp.). US Patent 4,155,664. 22 May 1979. Filed date 15 May 1978. 2p.

An end connector for joining with a similar connector to connect two fence sections of a floating oil boom is designed having a central channel and wing so that the wing of one connector is received within the channel of another connector and shoulders to allow for longitudinal movement only, a lock pin movable within a first slot into and out of the channel, a second slot in the wing within the channel to receive the lock pin whereby longitudinal motion of the two connectors is prevented and means for maintaining the lock pin the second slot in the locked condition including a latch plate with abutting camming surfaces.

4024 **Final environmental impact statement. Proposed Federal/State oil and gas lease sale, Beaufort Sea.** Anchorage, Alaska; Bureau of Land Management (1979). 66p. (NP—24118(Vol.3)). GPO.

This volume contains the following maps on the Federal/State Beaufort Sea: environmental geology, marine food web resources, fish resources, bird resources, marine mammals, terrestrial mammals, food web matrix, land status, biotic resource use areas, and cultural resources (potential, submerged archaeologic sites).

4025 **Final environmental impact statement. Proposed Federal/State oil and gas lease sale, Beaufort Sea.** Anchorage, Alaska; Bureau of Land Management (1979). 545p. (NP—24118(Vol.2)). GPO.

This volume contains supplementary materials relating to or consisting of: consultation and coordination, public hearings, letters of comments and responses to those letters, OCS planning schedule of proposed lease sales, various papers and forms on the proposed leases, Geological Survey's proposed Arctic operating orders, endangered species, US-USSR agreements, employment, etc. (DLC)

POLICY, LEGISLATION, AND REGULATION

4026 (EMD—79-31) **Petroleum pipeline rates and competition: issues long neglected by Federal regulators and in need of attention.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 13 Jul 1979. 87p. General Accounting Office, 441 G Street, NW, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

Regulators have not developed criteria for determining whether pipeline rates are reasonable and making sure that pipeline operators comply with the Interstate Commerce Act. In the absence of such criteria, GAO could not determine the extent to which consumers might have benefited from more effective regulation. Compared to other profitable companies - federally regulated or unregulated - the owners of many oil pipelines have received higher returns on their stockholders' equity and total capital. GAO recommends actions that the Attorney General and the Federal Energy Regulatory Commission should take to improve regulation of oil pipelines.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 4026, 4567

PROPERTIES

4027 (BETC/PPS—79/4) **Heating oils, 1979.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Oct 1979. 47p. Dep. NTIS, PC A03/MF A01.

Properties of 289 heating oils marketed in the United States were submitted for study and compilation under agreement between the Bartlesville Energy Technology Center (BETC) and the American Petroleum Institute (API). The fuels were manufactured by 29 petroleum refining companies in 98 domestic refineries. The data are tabulated according to six grades of fuel and subdivided into five geographic regions in which the fuels are marketed. The six grades of fuels are defined by the American Society for Testing and Materials (ASTM) Specification D396. The five regions containing a total of 16 marketing districts are shown on a map in the report. Trend charts are included showing average properties of the six grades of fuel for the past several years. Summaries of the results of the tests by grade and by region for 1979 compared with data for 1978 are shown in tables 1 through 6. Analyses of grades 4, 5(light), and 6 foreign import oils are presented in table 13.

NATURAL GAS

RESERVES

4028 (DOE/BG/01569—11) **Western Gas Sands Project. Quarterly basin activities report.** (CER Corp., Las Vegas, NV (USA)). 31 Aug 1979. Contract AC08-79BG01569. 38p. Dep. NTIS, PC A03/MF A01.

This report is a summation of three months drilling and testing activities in the four primary study areas of the WGSP: Greater Green River Basin, Northern Great Plains Province, Piceance Basin, and Uinta Basin. The core and the drilling programs are part of the resource assessment. (DLC)

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 3998

4029 (DOE/MC/10866—T1) **Shale characterization and resource appraisal of the Devonian black shales of the Appalachian basin. Quarterly report, April-June 1979.** de Witt, W. Jr. (Geological Survey, Reston, VA (USA)). 1979. Contract AI21-79MC10866. 4p. Dep. NTIS, PC A02/MF A01.

Progress during this period includes stratigraphy, structural studies, geophysics, source bed study, trace elements, clay mineralogy, etc. (DLC)

HEALTH AND SAFETY

4030 (LIB-tr—4461) **Fire protection when storing, transporting, and distributing liquified natural gas.** Biro, P. Translated from *Gas-Wasserfach, Gas-Erdgas;* **118**: No. 8, 344-346(1977). 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Portions of document are illegible.

This document presents notes on firefighting criteria for personnel responsible for the safety of LNG installations, so that adequate materials and equipment can be made available at the right place. Both storage and transport of LNG are covered. (DLC)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 4025, 4034, 4035, 4679, 4713

4031 (DOE/EIA—0145(78)) **Statistics of interstate natural gas pipeline companies, 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 290p. Dep. NTIS, PC A13/MF A01.

The 1978 financial and operating information of 86 Classes A and B interstate natural gas pipeline companies is presented in this volume with reported assets totaling $39.0 billion as of December 31, 1978, compared with the $35.8 billion on December 31, 1977. (1977 data in parentheses). Gross gas utility plant investments at the end of the year amounted to $30.4 billion ($28.0 billion); and net gas utility plant amounted to $16.5 billion ($15.2 billion). The Classes A and B Pipeline companies received total gas operating revenues of $25.9 billion ($22.3 billion) during the year 1978. This reflects the effect of inflation, of higher purchase gas cost, in addition to higher returns on equity capital needed to assure the financial integrity of the industry in the search for additional gas supplies. Sales of natural gas increased from 15.7 Tcf in 1977 to 16.2 Tcf in 1978. Sales of natural gas to ultimate consumers and to other gas utilities amounted to 2.6 trillion cubic feet (2.5 trillion cubic feet) and 13.6 trillion cubic feet (13.2 trillion cubic feet), respectively. Revenues from these sales amounted to $4.9 billion ($4.2 billion) and $19.9 billion ($16.9 billion), respectively. There was an average of 5,181,895 natural gas customers in 1978 compared with 5,084,329 in 1977. Of these averages, ultimate consumers numbered 5,179,233 (5,082,336) with 2,662 (1,993) wholesale gas utility customers.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 4024, 4037

4032 **Final environmental impact statement. Proposed Federal/State oil and gas lease sale, Beaufort Sea.** Anchorage, Alaska; Bureau of Land Management (1979). 409p. (NP—24118(Vol.1)). GPO.

About 208,091 hectares of OCS land are to be leased; they extend from the Canning River on the east to the Kuparuk River on the west. After a description of the environment (physical, biological, social, economic), the environmental impacts of the proposed leasing action are analyzed. Mitigating measures, unavoidable adverse effects, and alternatives are considered. (DLC)

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

4033 (DOE/BG/01569—13) **Western Gas Sands Project. Status report, 1 August-31 August, 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BG01569. 83p. Dep. NTIS, PC A05/MF A01.

This status report summarizes progress of government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. Work on fracture conductivity, rock-fluid interaction, and log evaluation and interpretation techniques continued at Bartlesville. Work commenced on completing, testing and possible hydraulic fracturing of the Rio Blanco Natural Gas Company well No. 397-19-1 and on the evaluation of seismic data for stratigraphic studies of lenticular sands. LLL continued experimental and theoretical work on hydraulic fracturing mechanics and analysis of well test data. LASL worked on developing NMR methods to define fluid saturation, porosity, and permeability of western gas sands at in situ conditions. M.D. Wood, Inc. was involved in design and site preparation for two hydraulic fracture mapping jobs in the Cotton Valley Trend in Texas. Testing and analyses of the borehole seismic system and borehole hydrophone system continued at Sandia. Field tests and related activities for the WGSP progressed as scheduled in August. Cyclic injection of dehydrated natural gas and production in Colorado Interstate Gas Company's Miller No. 1 and Sprague No. 1 wells continued. The Gas Producing Enterprises, Inc. wells, Natural Buttes Units 9, 14, 18 and 20 flowed to sales. The Mitchell Energy Corporation Muse-Duke No. 1 was shut-in for a 15-day pressure buildup test. Hydraulic fracture containment experiments and activities in the multi-frac test series continued at the Nevada Test Site for Sandia Laboratories' mineback program.

POLICY, LEGISLATION, AND REGULATION

4034 (DOE/EIA—0102/28) **Revenues to natural gas producers under alternative regulatory assumptions. Analysis memorandum AM/ES/78-07.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 12 Jun 1978. 41p. NTIS, MF A01.

This report presents a forecast of natural gas producer revenues through 1985 under four legislative options: continuation of present system of regulation of natural gas prices; the natural gas pricing provisions of H.R. 8444 as passed by the House; the natural gas pricing legislation which passed the Senate; and the tentative agreement announced by the caucus of House-Senate conferees on April 20. It does so by providing a range of estimates instead of a point estimate or best guess of the revenue effects.

4035 (DOE/EIA—0150(79-80)(P)) **Projected natural gas deliveries and curtailments to end-use customers 1979-1980 heating season (November-March). Preliminary report.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 6 Nov 1979. 14p. Dep. NTIS, PC A02/MF A01.

Data in this report are the preliminary tabulations of a survey of approximately 1500 gas companies (utilities, pipelines, and producers) that supply natural gas to end-use customers. Tables presented provide data on volumes of end-use customer deliveries and curtailments. All information included deal only with markets for end-use.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 4567

4036 **Tools, techniques, and training for altering and repairing pressurized pipe systems.** Chicago, IL; Institute of Gas Technology (Apr 1979). 237p. (CONF-7811133—). $25.00.

From Symposium on the tools, techniques and training for altering and repairing pressurized pipe systems; Chicago, IL, USA (13 Nov 1978).

This opening paper for the symposium contains an introduction to pressurized distribution systems and the maintenance of fluid pressure during routine and emergency work on these systems. Continuity of service is stressed; and the work methods, tools, and training needed to maintain pressure while altering and repairing such systems are outlined. Scope of the symposium is stated and certain omissions from papers are cited in order that any lack of importance is not implied by such omission. These include ordinary leak clamping, underpressure shutoff, and the use of pressure gauges;

this introductory paper includes remarks on each and an appendix on underpressure shutoff. In addition, a recently developed add-on stopper/valve is described as a useful device with probable manufacture a year or two away. Separate abstracts were prepared for the following 18 papers.

PROPERTIES

4037 (UCRL—83317) **Battery-powered, differential infrared absorption sensor for methane, ethane, and other hydrocarbons.** Bingham, G.E.; Gillespie, C.H.; McQuaid, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1979. Contract W-7405-ENG-48. 21p. (CONF-790887—1). Dep. NTIS, PC A02/MF A01.

From Gas Research Institute symposium on methane detection and measurements; Chicago, IL, USA (27 Aug 1979).

This report presents the performance goals, design considerations, and physical details of the miniature infrared absorption sensor being developed for the US DOE's Liquefied Natural Gas Spill Safety Program. The sensor is lightweight, battery-powered, portable, self-contained, and able to interface readily to large-array data systems. Essentially a precision infrared differential spectrometer capable of operating over the full range of gas concentrations expected in the spill diffusion tests, the sensor is expected to cost less than $7000 per unit. The present design of this open-cell, fast-response sensor allows it to measure two components, but it can be modified to measure additional components at a reduced sampling frequency. To minimize temperature effects and power consumption, the sensor has a single-source, single-detector design which includes a rotating chopper-filter wheel. A CMOS microprocessor interfaced with a fast arithmetic chip is used to linearize sensor output and correct for component interference.

STORAGE

4038 (LIB-tr—4698) **Gas storage caverns in the salt formation at Epe.** Costinescu, A. Translated from *Erdoel-Erdgas Z.*; **94**: No. 6, 27(1978). 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The first step in the design of the Epe natural gas storage caverns was the analysis of the geological data obtained during the drilling and leaching process. The relations between the salt back and pillar thicknesses on the one hand and the cavern diameters, depths, and pressures on the other hand were determined on the basis of rock mechanical studies. With the help of these data, the limited extension and thickness of the salt deposit and the given well-pattern, the caverns were optimized so as to achieve the largest possible volumes of the individual caverns with a view to maximum salt production and minimum investments for gas storage. The refitting of the cavern wells from leaching operation to gas storage operation raised technical problems, in particular in some of the drillings originally planned for brine recovery only, which were overcome with the help of special equipment. The gathering lines and the bulk of the process plant were designed for a working pressure of 200 bar. The operating experience made since 1976 confirms expectations. Withdrawal rates of over 200,000 m^3/h/cavity could be realized. The PVT behavior of the gas stored measured under cavern conditions largely confirmed the results of a thermodynamic study made for the project.

OIL SHALES AND TAR SANDS

SITE GEOLOGY

REFER ALSO TO CITATION(S) 4029

DRILLING, FRACTURING, AND MINING

4039 (LA—7929) **Theory of explosions in anisotropic media.** Dienes, J.K. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

When a suitable process for retorting of oil shale has been devised it will become possible to extract large amounts of kerogen, a potential substitute for oil. We have been studying the mechanics of fragmenting oil shale by means of explosives, with an emphasis on layering effects, and in this report we describe the response of a transversely isotropic material to a spherical explosion. At high pressures the constitutive law is essentially the (isotropic) Mie-Gruneisen equation of state, whereas at lower pressures it approaches an elastic, ideally plastic formulation exhibiting transverse isotropy. Elastic and plastic strain rates are superposed to obtain the total strain rate in the usual fashion. Because we intended to use the constitutive law in a standard continuum computer code, it was necessary to invert the resulting relation to obtain stress rate as a function of strain rate. The resulting constitutive law has been incorporated into the continuum ALE (Arbitrary Lagrangian-Eulerian) computer code, YAQUI. Contrary to our initial expectations, the cavity computed at late times is spherical to within a few percent. Though at early times the shock wave is also spherical, the effects of anisotropy subsequently become very strong. Tensions that are not present in isotropic media appear near a 45° cone and suggest a new method of fracturing.

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 4046

4040 (FE—1747-6) **BX In Situ Oil Shale Project. Quarterly technical progress report, June 1, 1978-August 31, 1978.** Dougan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 20 Sep 1978. Contract ET-78-F-03-1747. 78p. Dep. NTIS, PC A05/MF A01.

Objective of this project is to demonstrate the technical feasibility of using superheated steam as a heat-carrying medium to retort in situ the oil shale in the Green River Formation leached zone and provide a mechanism for the recovery of this shale oil with a minimum impact on the environment. During this period, work on the BX In Situ Oil Shale Project consisted of drilling project wells; the running of additional pulse tests with consequent redesign of the well completion format; and the commencement of construction of surface facilities.

SURFACE METHODS

4041 (PB—294680) **Recovery of oil from Utah's tar sands. Final report 1975-77.** Oblad, A.G.; Seader, J.D.; Miller, J.D.; Bunger, J.W.; Cogswell, D.E. (Utah Univ., Salt Lake City (USA)). 1977. 156p. NTIS PC A08/MF A01.

Utah has at least 25 billion barrels of potential oil or bitumen existing as tar sands. In this program, methods for extracting the bitumen from the sands, analyzing and characterizing the products, and upgrading the bitumen were studied. In particular, the extraction of bitumen from Utah tar sands by a hot-water digestion and flotation technique and by a thermal, fluidized-bed technique are shown to be feasible.

4042 (UCRL—82482) **Dispersion in oil shale retorts: effect of particle size distribution and flow nonuniformities.** Carbonell, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 6p. (CONF-790803—63). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

This paper considers the effects of particle size distribution and flow nonuniformities on the dispersion of an inert tracer in porous media using some simplified models, and compares the results to recent dispersion data taken on external retorts filled with oil shale particles. The effect of the particle size distribution is analyzed by studying the dispersion of a tracer in a series of infinite parallel pores of varying diameters. The Peclet number dependence is in agreement with experimental measurements, as is the qualitative dependence on particle size distribution. The effect of flow nonuniformities is studied by analyzing the dispersion of an inert tracer in a packed bed with two annular regions of different interstitial velocities. The dispersion coefficients measured in external retorts or packed beds filled with oil shale particles are much higher than those previously measured using uniform particles of the same average size. These differences can be accounted for if one allows for the possibility of having a significant contribution from flow nonuniformities.

4043 **Oil shale retort apparatus and process.** Thomas, D.D. US Patent 4,146,460. 27 Mar 1979. Filed date 9 Sep 1977. 6p.

A gravity feed inclined retort apparatus provides for a distillation process in which oil is removed from shale ore in the inclined portion of the retort, and the gaseous oil is removed to a vapor condenser/separator in which the vapor is condensed into the product oil. The retorted shale is fed onto a continuous chain stoker, or other similar conveying device, where the coke portion of the retorted shale is burned as fuel for the retort. Hot gases from the combustion zone where air is directed through the burning coke are used to preheat the shale ore above the dew point of the oil, through a heat exchange plate; and the hot gases then flow through the shale ore in the retort chamber, picking up the oil vapors from the heated shale, and carrying this oil-filled gas into a vapor condenser/separator. Some of the oil vapors are also condensed onto cooled side walls extending along the retort chamber and this condensed oil flows into

oil collection gutters. The retort chamber is slightly enlarged along its length in the downward direction of shale movement to preclude clinkering and blockage of the continuous operation. The retort chamber is oriented at approximately 45° from the horizontal for gravity feed; and the heat exchange plate is raised at its center and pitched at an angle of about 15° relative to a line extending across its width for free shale movement down the expanding retort chamber. 17 claims.

REFINING

REFER ALSO TO CITATION(S) 3959, 3960

4044 (DOE/ET—2628/1) **Market assessment for shale oil.** (Pace Co. Consultants and Engineers, Inc., Houston, TX (USA); Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Oct 1979. Contract ET-78-C-01-2628. 122p. Dep. NTIS, PC A06/MF A01.

This study identified several key issues on the cost, timeliness, and ease with which shale oil can be introduced into the United States' refining system. The capacity of the existing refining industry to process raw shale oil is limited by the availability of surplus hydrogen for severe hydrotreating. The existing crude oil pipeline system will encounter difficulties in handling raw shale oil's high viscosity, pour point, and contaminant levels. The cost of processing raw shale oil as an alternate to petroleum crude oil is extremely variable and primarily dependent upon the percentage of shale oil run in the refinery, as well as the availability of excess hydrogen. A large fraction of any shale oil which is produced will be refined by the major oil companies who participate in the shale oil projects and who do not anticipate problems in processing the shale oil in their refineries. Shale oil produced for sale to independent refiners will initially be sold as boiler fuel. A federal shale oil storage program might be feasible to supplement the Strategic Petroleum Reserve. Based on refinery configurations, hydrogen supply, transportation systems, and crude availability, eleven refineries in Petroleum Administration for Defense Districts (PADDs) 2A and 2B have been identified as potential processors of shale oil. Based on refining technology and projected product demands to the year 2000, shale oil will be best suited to the production of diesel fuel and jet fuel. Tests of raw shale oil in boilers are needed to demonstrate nitrogen oxide emissions control.

PROPERTIES AND COMPOSITION

4045 (AD-A—062420) **Aging behavior of crude shale oil. Progress report.** Hazlett, R.N.; Hall, J.M.; Burnett, J.C. (Naval Research Lab., Washington, DC (USA)). Aug 1978. 11p. NTIS PC A02/MF A01.

Crude shale oil produced by the Paraho retort was heated for eight weeks at 50 C. This corresponds to at least one year of storage at ambient conditions. Increases in oil viscosity and in the content of high molecular weight compounds were observed, but pour point changes were minimal. The overall changes at the experimental conditions used are modest.

4046 (CONF-7906106—9) **Change in mechanical properties of Antrim oil shale on retorting.** Singh, S.P.; Hockings, W.A.; Kim, K. (Michigan Technological Univ., Houghton (USA)). 1979. Contract EX-76-C-01-2346. 6p. Dep. NTIS, PC A02/MF A01.

From 20. US symposium on rock mechanics; Austin, TX, USA (3 Jun 1979).

The decomposition of kerogen in oil shale and subsequent extraction of the decomposition products during the retorting process are known to alter the pore structure, resulting in changes in permeability, deformation and strength properties. Prediction of these changes is of fundamental importance in the design of in-situ retorting processes. This paper summarizes a comprehensive laboratory investigation on the changes in mechanical properties of Antrim oil shale on retorting at 500°C. It was observed that kerogen plays an important role in the change of the properties on retorting. When subjected to heat, the degree of deformation, the extent of fracturing and the structural instability of the specimens appeared to be strongly dependent upon kerogen content. The values of elastic modulus, strength, and density decreased whereas maximum strain at failure increased on retorting. Significant increases in permeability and porosity also resulted from retorting. The most pronounced increase was observed in the permeability in the direction parallel to bedding which exceeded in some cases as much as 3 orders of magnitude. Microscopic observations of pore structures provided a qualitative support to data obtained in measurements of porosity and permeability.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 4929

NUCLEAR FUELS

EXPLORATION

4047 (GJBX—135(79)) **Integration of NURE and other data sets with emphasis on their utilization in generating exploration models in the Lubbock, TX 1° x 2° Quadrangle.** Lankston, M.M.; Lankston, R.W. (G-Cubed, Inc., Spokane, WA (USA)). May 1979. Contract EY-76-C-13-1664. 303p. Dep. NTIS, PC E09/MF E09.

The study reviewed the geology of the region covered by the Lubbock, Texas 1° x 2° NTMS Quadrangle. The geology was integrated with NURE aerial radiometric data that had been recorded before the study was undertaken. The integration indicates that several of the geologic units in the area have recognizable radiometric signatures. These signatures were checked and substantiated by two ground radiometric survey systems, one truck-mounted and one hand-held. Numerous areas were seen which suggested that areas had been mismapped, that recent wind or stream action had modified the surface exposure of units, or that the radiometric data acquisition systems were able to detect surface units which were too small to be presented at the scale of the published geologic map. Two exploration models for the Lubbock region are proposed. The first and most obvious model involves basal Dockum (Triassic) sandstone which has been known for twenty years as a potentially economic uranium zone. The second model is more speculative. By integrating subsurface geologic data, NURE HSSR data, and ground and airborne radiometric data, a band of anomalies is seen extending in a generally north-south direction at the edge of the maximum eastern subsurface extent of Cretaceous rocks. Related to this band of anomalies is the group of very high radiometric anomalies over the Pleistocene lake basins in the southwestern corner of the study area. The basins also may be potential exploration targets.

4048 (GJBX—139(79)(Vol.2)) **Aerial radiometric and magnetic survey: Dickinson National Topographic Map, North Dakota.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 136p. Dep. NTIS, PC A07/MF A01.

Flight line profile data are presented.

4049 (GJBX—145(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Albuquerque NTMS Quadrangle, New Mexico, including concentrations of forty-three additional elements.** Maassen, L.W.; Bolivar, S.L. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 239p. (LA—7508-MS). Dep. NTIS, PC A11/MF A01.

The Los Alamos Scientific Laboratory conducted a hydrogeochemical and stream sediment reconnaissance for uranium. Totals of 408 water and 1538 sediment samples were collected from 1802 locations over a 20 100-km² area at an average density of one location per 11 km². Water samples were collected from springs, wells, and streams; sediments samples were collected predominantly from streams, but also from springs. All water samples were analyzed for uranium and 12 other elements. Sediment samples were analyzed for uranium and 42 additional elements. The uranium concentrations in water samples range from below the detection limit of 0.02 ppB to 194.06 ppB. The mean uranium concentration for all water types containing < 40 ppB uranium is 1.98 ppB. Six samples contained uranium concentrations > 40.00 ppB. Well waters have the highest mean uranium concentration; spring waters have the lowest. Clusters of water samples that contain anomalous uranium concentrations are delineated in nine areas. Sediments collected from the quadrangle have uranium concentrations that range between 0.63 ppM and 28.52 ppM, with a mean for all sediments of 3.53 ppM. Eight areas containing clusters of sediments with anomalous uranium concentrations are delineated. One cluster contains sample locations within the Ambrosia Lake uranium district. Five clusters of sediment samples with anomalous uranium concentrations were collected from streams that drain the Jemez volcanic field. Another cluster defines an area just northeast of Albuquerque where streams drain Precambrian rocks, predominantly granites, of the Sandia Mountains. The last cluster, consisting of spring sediments from Mesa Portales, was collected near the contact of the Tertiary Ojo Alamo sandstone with underlying Cretaceous sediments. Sediments from these springs exhibit some of the highest uranium values reported and are associated with high uranium/thorium ratios.

4050 (GJBX—146(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Moab NTMS Quadrangle, Utah/Colorado, including concentrations of forty-three additional elements.** Goff, S.J.; Warren, R.G. (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract EY-76-C-13-1664. 207p. (LA—7509-MS). Dep. NTIS, PC A10/MF A01.

During the summers of 1976, 1977, and 1978, 442 water and 1755 sediment samples were collected from 1801 locations within the 19 400 km² area of the Moab quadrangle. Water samples were collected from streams, springs, and wells; wet and dry sediment

samples were collected both from stream channels and from springs. Each water sample was analyzed for 13 elements, including uranium, and each sediment sample was analyzed for 43 elements, including uranium, thorium, and vanadium. Uranium concentrations in water samples range from below the detection limit of 0.02 to 1874.22 ppB and have a median of 0.67 ppB and a mean of 8.46 ppB uranium. Nearly half of the water samples containing high uranium concentrations were downstream from workings within the Lisbon Valley or La Sal Creek mining areas. High uranium concentrations were also found in several water samples where uranium mineralization is not known. These samples are from streams and shallow wells that drain separate areas in the Morrison formation and in the Mancos shale. Uranium concentrations in sediment samples range from 0.74 to 108.6 ppM and have a median of 2.56 ppM and a mean of 3.06 ppM uranium. Most of the sediment samples containing >10 ppM U are directly downstream from mines or in the immediate vicinity of ore reduction plants. Only one sediment sample containing >10 ppM uranium is outside mining activity, but the uranium-to-thorium ratio (U/Th) indicates that this location might be associated with uranium mineralization east of the Uravan Mineral Belt.

4051 (GJBX—147(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Lander NTMS Quadrangle, Wyoming, including concentrations of forty-three additional elements.** Shannon, S.S. Jr. (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract EY-76-C-13-1664. 217p. (LA—7512-MS). Dep. NTIS, PC A10/MF A01.

Totals of 355 water and 1376 sediment samples were collected from 1441 locations at an actual density of one sample location per 13 km² over an 18,260-km² area. Water samples were collected from streams, springs, and wells; sediment samples were collected from streams, springs, and dry ponds. Water samples were analyzed for uranium and twelve additional elements. The mean uranium content of all water samples from the Lander quadrangle is 3.80 ppB. Clusters of water samples containing more than 10 ppB uranium, the arbitrary anomaly threshold chosen for this report, are associated with undivided Miocene strata of the Moonstone, White River, Bridger, Wind River, Green River, and Battle Spring formations, Cody shale, Chugwater and Phosphoria formations, and undivided Precambrian rocks. Sediment samples were analyzed for uranium, thorium, and 41 other elements. The mean uranium content of all sediment samples is 3.96 ppM. Major clusters of sediment samples containing more than 10 ppM uranium, the arbitrary anomaly threshold, are limited to areas underlain by unconsolidated Quaternary sediments; the White River, Bridger, Green River, Wasatch, and Battle Spring formations and undivided Miocene strata; the Chugwater formation of Triassic age; lower Paleozoic strata; and quartz diorite and quartz monzonite of Precambrian age. Several of these areas include samples having high U/Th ratios. The maximum uranium values both in water and in sediment samples from the Lander quadrangle were obtained from a stream at the Lost Creek uranium mine in the Great Divide Basin. The chief ore mineral is schroeckingerite, a water-soluble mineral that contains considerable sodium. Other sediment samples from this area that contain anomalous uranium values also have high sodium and chlorine contents and high uranium/thorium ratios, suggesting extraordinarily high mobility of uranium in the Great Divide Basin.

4052 (GJBX—152(79)) **Williamsport 1° x 2° NTMS area Pennsylvania: data report.** Heffner, J.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1979. Contract EY-76-C-13-1664. 374p. (DPST—79-146-8). Dep. NTIS, PC E07/MF E07.

Preliminary results of ground water, stream sediment, and stream water reconnaissance in the National Topographic Map Series (NTMS) Williamsport 1° x 2° quadrangle are presented. Stream sediment and stream water samples were collected from small streams at 970 sites or at a nominal density of one site per 18 square kilometers in rural areas. Ground water samples were collected at 1276 sites or at a nominal density of one site per 15 square kilometers. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water and surface water. Field measurments and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Key data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) well depth, (3) element analyses (U, Br, Cl, F, Mn, Na, and V), and (4) graphical presentation only of Al and Dy analyses. Supplementary data include site descriptors (well age, frequency of use of well, etc.) and tabulated analytical data for Al and Dy. Key data from stream sediment sites include (1) water quality measurements (pH, conductivity, and alkalinity), and (2) important elemental analyses (U, Th, Hf, Al, Ce, Fe, Mn, Sc, Na, Ti, and V). Supplementary data from stream sediment sites include sample site descriptors (stream characteristics, vegetation, etc.) and additional elemental analyses (Dy, Eu, La, Lu, Sm, and Yb). Key data from stream water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity) and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V).

4053 (GJBX—157(79)(Vol.1)) **Aerial gamma ray and magnetic survey: Raton Basin Project, the Flagstaff Quadrangle of Arizona. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Aug 1979. Contract EY-76-C-13-1664. 79p. Dep. NTIS, PC E07/MF E07.

In 1978, geoMetrics, Inc., collected 3278 line miles of high sensitivity airborne radiometric and magnetic data in Arizona within the Flagstaff 1° x 2° NTMS quadrangle. This quadrangle represents part of the Raton Basin Project. All radiometric and magnetic data for the Flagstaff quadrangle were fully reduced and interpreted by geoMetrics and are presented as two volumes. The Flagstaff quadrangle lies primarily within the Colorado Plateau Physiographic Province. The Black Mesa Basin is the dominant geologic structure, occupying 75% of the survey area. It is bordered by Mogollon Rim and the Kaibab Uplift on the west and south. Two large Tertiary volcanic fields lie in the quadrangle. The majority of exposed rocks are nonmarine sediments of Mesozoic Age, and volcanics of Tertiary Age. Scattered minor occurrences of uranium are found in Triassic rocks in the central portion of the quadrangle.

4054 (GJBX—157(79)(Vol.2)) **Aerial gamma ray and magnetic survey: Raton Basin Project, Flagstaff quadrangle, Arizona. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Aug 1979. Contract EY-76-C-13-1664. 316p. Dep. NTIS, PC A14/MF A01.

The Flagstaff quadrangle in northern Arizona lies at the southwestern edge of the Colorado Plateau. Portions of the Black Mesa Basin and Mogollon Rim lie within the quadrangle. Mesozoic rocks cover 90% of the surface of the Black Mesa Basin, but Paleozoic rocks dominate the Mogollon Rim. Cenozoic instrusive and extrusive rocks of the San Francisco Volcanic Field and the Hopi Buttes are superimposed on the older sedimentary sequence. Magnetic data apparently show contributions from both deep and shallow sources. The San Francisco Volcanic Field is relatively well defined, but deeper-lying structural boundaries are largely masked by the younger igneous rocks in the area. The Flagstaff quadrangle has been relatively unproductive in terms of uranium mining. Some claims are present in the Black Mesa Basin, primarily in Triassic rocks. A total of 195 groups of sample responses in the uranium window qualify as anomalies as defined in Volume I. These anomalies primarily form two distinct groups, though others are scattered throughout the quadrangle. One group is associated with igneous rocks in the northern Hopi Buttes area, and the other, a larger and more indistinct group, is primarily associated with the Shinarump Member of the Triassic Chinle Formation in the northern Painted Desert area. None are directly associated with the locations of known claims.

4055 (GJBX—158(79)(Vol.2)) **Aerial gamma ray and magnetic survey: Powder River II Project, Casper quadrangle, Wyoming. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Aug 1979. Contract EY-76-C-13-1664. 370p. Dep. NTIS, PC A16/MF A01.

The Casper quadrangle in central Wyoming lies within the Wyoming Basins Province and contains portions of several basins and uplifts of this province. Each of the basins contains a moderate to thick sequence of Phanerozoic strata. Precambrian rocks are exposed in the Sweetwater and Laramie Uplifts. Magnetic data appear to illustrate the relative depth to Precambrian basement and define the bundaries of the major structures very well. The Casper quadrangle has been extremely productive in terms of uranium mining, and contains three of the largest uranium mining districts in Wyoming. The uranium is found in Tertiary arkosic sandstones of the Wind River and Fort Union Formations. Other small districts are also present within the quadrangle in which uranium mineralization occurs in a variety of rocks. This project contains radiometric and magnetic data gathered by Texas Instruments, Inc. and geoMetrics. Despite an attempt at normalization, some minor differences exist between the two data sets. A total of 122 groups of sample responses in the uranium window constitute anomalies as defined in Volume I. These anomalies are largely scattered throughout the quadrangle, but tend to group within and around known uranium deposits. The anomalous samples are found most frequently associated with Cenozoic strata and Precambrian crystalline material.

4056 (GJBX—158(79)(Vol.2)(Torrington)) **Aerial gamma ray and magnetic survey: Powder River II Project, Torrington quadrangle, Wyoming and Nebraska. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Aug 1979. Contract EY-76-C-13-1664. 276p. Dep. NTIS, PC A13/MF A01.

The Torrington quadrangle in southeastern Wyoming and western Nebraska lies at the juncture of the Power River, Denver, and Shirley Basins; bordered by the Laramie and Hartville Uplifts. Each of the basins contains a moderate to thick sequence of Paleozoic and Mesozoic - Tertiary rocks covering 90% of the surface of the Denver and Power River Basins. Substantial amounts of Precambrian rocks are exposed in the Laramie Uplift. Magnetic data appear to illustrate the relative depth to Precambrian basement, and define

the boundaries of the major structural features moderately well. The Torrington quadrangle has been only moderately productive despite its location near the major uranium producing areas in Wyoming. Some claims (prospects) are present. These claims are located primarily in Tertiary rocks, and in some areas in Precambrian exposures. A total of 155 groups of sample responses in the uranium window constitute anomalies as defined in Volume I. These anomalies are scattered throughout the quadrangle, but are found most frequently associated with Tertiary sediments and Precambrian crystalline material. A few anomalies correspond to known uranium claims.

4057 (GJBX—161(79)) **Delta and Richfield 1° x 2° NTMS areas, Utah: data report.** Jones, P.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1979. Contract EY-76-C-13-1664. 148p. (DPST—79-146-12). Dep. NTIS, PC E04/MF E04.

This data report presents results of stream sediment reconnaissance in the National Topographic Map Series (NTMS) Delta and Richfield 1° x 2° quadrangles. Stream sediment samples were collected for the Lawrence Livermore Laboratory. Samples were collected at 1008 sites in the Delta quadrangle and at 1028 sites in the Richfield quadrangle. Neutron activation analysis (NAA) results are given for uranium and 16 other elements. Analytical data are presented in tables. Statistical summaries of data are given. Key data are presented in page-size hard copy. Supplementary data are on microfiche. Key data include important elemental analyses (U, Th, Hf, Al, Ce, Fe, Mn, Sc, Na, Ti, and V). Supplementary data include additional elemental analyses (Dy, Eu, La, Lu, Sm, and Yb), and SRL-LLL identification number conversion tables.

4058 (GJBX—163(79)) **Aerial radiometric and magnetic survey: Socorro National Topographic Map, New Mexico.** (Geodata International, Inc., Dallas, TX (USA)). 28 Sep 1079. Contract EY-76-C-13-1664. 378p. Dep. NTIS, PC E20/MF E20.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Socorro National Topographic Map NI13-4 is presented in this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included.

4059 (GJBX—164(79)) **Aerial radiometric and magnetic survey: Death Valley National Topographic Map, Nevada, California.** (Geodata International, Inc., Dallas, TX (USA)). 17 Sep 1979. Contract EY-76-C-13-1664. 606p. Dep. NTIS PC E99/MF E99.

The results of analysis of the airborne gamma radiation survey flown for the region identified as the Death Valley National Topographic Map NJ11-11 is presented in the bound Volume of this report. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

4060 (SAND—78-2345C) **Direct uranium measurement by the prompt fission neutron method of pulsed neutron borehole logging.** Bivens, H.M.; Jensen, D.H.; Barnard, R.W.; Stephenson, W.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 28p. (CONF-7905120—1). Dep. NTIS, PC A03/MF A01.

From New Mexico Bureau of Mines and Mineral Resources conference; Albuquerque, NM, USA (13 May 1979).

Objectives of the prompt fission neutron (PFN) logging project consist of a feasibility determination, development of the PFN method and log interpretation, field demonstration of the PFN method and hardware, and support for the commercialization of hardware. This paper presents the current status of the PFN development project. 10 figures. (DLC)

FEED PROCESSING

REFER ALSO TO CITATION(S) 4913, 4914, 4922

4061 (ORNL/TM—6488) **Graphical determination of the radionuclide inventory in the concentrate and tailings from processing facilities.** Crawford, D.J. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 42p. Dep. NTIS, PC A03/MF A01.

During radiological surveys of radionuclide processing facilities, one must make a determination of the expected inventory of all members of the three naturally occurring radionuclide decay chains. A set of graphs has been developed that display the decay and ingrowth of all members of the ^{232}Th, ^{238}U, and ^{235}U decay series. These graphs may be used in the field to predict present inventories from a knowledge of previous inventories. Equations used to generate several of the graphs are given in tables. 20 figures, 4 tables.

4062 **Decommissioning of a high-enriched $UF_6 \rightarrow UO_2$ conversion facility: nondestructive assay assistance.** Hughes, M.B. (Babcock and Wilcox Co., Lynchburg, VA); Hardt, T.L.; Dedo, M.P. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 25(1979).

4063 **Nondestructive analysis of SNM at B and W's uranium conversion plant.** Hardt, T.L. (Babcock and Wilcox Co., Lynchburg, VA); Hughes, M.B.; Dedo, M.P. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 25-26(1979).

ENRICHMENT

REFER ALSO TO CITATION(S) 4783

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 4078, 4083, 4118, 4119, 4123, 4856, 4865

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 4102, 4103, 4104, 4105, 4106, 4107, 4108, 4109, 4110, 4111, 4112, 4113, 4115, 4120, 4121, 4122, 4123

4064 **System for nondestructive assay of spent-fuel subassemblies: comparison of calculations and measurements.** Ragan, G.L.; Ricker, C.W.; Chiles, M.M.; Ingersoll, D.T.; Slaughter, G.G.; Williams, L.R. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 33-34(1979).

4065 **Monte Carlo calculational design of an NDA instrument for the assay of waste products from highly enriched spent fuels.** Eccleston, G.W.; Schrandt, R.G.; MacDonald, J.L. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 36-37(1979).

4066 **Spectrophotometric determination of plutonium in irradiated fuels solutions: procedures and shielding facilities.** Bouzou, M.C.; Brutus, A.A. (Etablissement de Marcoule, Bagnols, France). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 37-38(1979).

4067 **Deviations from mass transfer equilibrium and mathematical modeling of mixer-settler contactors.** Beyerlein, A.L.; Geldard, J.F.; Chung, H.F.; Bennett, J.E. (Clemson Univ., SC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 56-58(1979).

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 4082, 4101, 4567

4068 (AGNS—35900-1.5-37) **Studies and research concerning BNFP: assistance to Department of Energy. Final report.** Darr, D.G.; Highberger, P.F. (Allied-General Nuclear Services, Barnwell, SC (USA)). Sep 1979. Contract EY-76-C-09-0001. 21p. Dep. NTIS, PC A02/MF A01.

During FY 1979, the Savannah River Operations Office of the Department of Energy requested Allied-General Nuclear Services undertake the following special studies: (1) early receipt and storage of foreign spent fuel; (2) safety and environmental impact of interim AFR storage in the BNFP-FRSS; and (3) status of BNFP licensing. Each of the above studies was completed and a report issued during FY 1979.

4069 (LA—7969-PR) **Fission product release. Progress report, April 1-June 30, 1979.** Norris, A.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 15p. (ONWI/Sub—79/E511-01200-12). Dep. NTIS, PC A02/MF A01.

Experiments continued this quarter to measure the rates of leaching reactor products from spent UO_2 fuel under oxidizing and reducing conditions. One pair of spent fuel wafers was leached in deionized water for 65 days at 25°C. Then the temperature was raised to 70°C. Lanthanide and actinide elements were observed to be leached at one-tenth the rate under reducing conditions at 25°C than under oxidizing conditions. At 70°C, the rates of leaching these elements decreased. After 30 days at the higher temperature, the differences between oxidizing and reducing conditions no longer were apparent in the leach rate data. A second pair of spent fuel wafers was leached at 25°C under the same conditions as the first pair. Duplicate results were obtained. In experiments to measure the rate of dissolution of finely divided UO_2 in deionized water, values of 9×10^{-7} and 6×10^{-7} g $cm^{-2}day^{-1}$ were obtained at a pH of 4.1 and an Eh of +0.5 V. Similar measurements were made at an Eh of -0.15 V, but the data could not be interpreted in terms of a UO_2 dissolution rate.

WASTE MANAGEMENT

4070 (DOE/TIC—10294) **Management of radioactive wastes.** Blomeke, J.O. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

This paper reviews the nature and characteristics of the radwastes, status of the work that has been done, options that are available in waste management, and plans and expectations for the near future. (DLC)

4071 (LA—7857) **Low-level transuranic waste assay by photon interrogation and moderated neutron counting.** Cates, M.R.; Franks, L.A.; Noel, B.W.; Pigg, J.L.; Close, D.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

When fission is induced in trace amounts of transuranic contaminants in waste material, it provides signatures from fission products that can be used to assay the material before disposal. Given here are the results from counting photofission-induced delayed neutrons from ^{239}Pu in sample matrices. When delayed neutrons emitted after 5 min of photon irradiation with energies up to 18 MeV in 1-l samples are counted, assay limits of 10 to 100 nCi/g for matrices with a density of up to 5 g/cm^3 are determined. Counting all delayed neutron emissions or some prompt neutrons improves sensitivities by a factor of 20 or more. The dynamics of photofission and delayed neutron production, use of an electron linear accelerator as a particle source, experimental and electronic details, and future experimental plans are discussed. 15 figures, 3 tables.

4072 (ORNL/OIAPA—13) **Public information on radioactive waste: a study of an emerging issue.** Bronfman, L.M.; Bronfman, B.H.; Regens, J.L. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

Through an analysis of information provided in the printed media on the topic of radioactive waste, the study analyzes the emergence of radioactive waste as a public issue in the press. Over eight hundred articles printed in both specialized and non-specialized sources from 1973 to 1978 have been content-analyzed in order to describe how the problem of radioactive waste is defined and what dimensions of the problems are receiving attention. Between 1973 and 1978, there was a substantial increase in the amount of information on the topic of radioactive waste available to the public through a variety of popular and specialized media sources. This increase coincides with documented public concern with the problem of radioactive waste. Discussions of radioactive waste have focused for all sources more frequently on themes not directly related to the technical problems of radioactive waste storage or isolation. A substantial amount of the information available to a variety of segments of the public is composed of discussions of real or perceived risk related to the existence of waste or to methods of disposing of it. In addition to risk, a substantial proportion of the discussions deal with institutional themes. Over time, the total amount of information on most dimensions of the radioactive waste problem has increased substantially. Institutional themes have gained relative to other issues over the three time periods. National and local press sources infrequently specify the form of waste being discussed thus providing evidence that the quality of technical information available to some members of the public is very low.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 4123

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 4114

4073 (DP-MS—79-49) **Equipment for collecting sludge samples from Savannah River Plant waste tanks.** Allen, B.M. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 16p. Dep. NTIS, PC A02/MF A01.

A sampler was developed to take 25-L samples of sludge from Savannah River Plant waste tanks. The cylindrical sample vessel has a retractable nose section. Sludge enters an annular space at the nose section as the sampler is forced through the sludge layer with rigid drive pipes. Two samples have been taken and transported in a special cask to a waste processing research facility at the Savannah River Laboratory. 7 figures.

4074 (PB—295038) **A survey of packaging for solidified low-level radioactive waste. Technical note.** Miller, N.E. (Battelle Columbus Labs., OH (USA)). Sep 1978. Contract EPA-68-01-3924. 46p. NTIS PC A03/MF A01.

There are presently no federal regulations controlling the packaging of low-level radioactive wastes for disposal by shallow land burial. The packaging of low-level radioactive wastes for ocean disposal by the European community has been controlled by guidelines of the Nuclear Energy Agency of the OECD. For both methods of disposal, the 55-gallon steel drum has been the most commonly used container. The use of nonmetal packaging has been more common for contaminated trash and other low-level wastes at DOE shallow land burial sites. The life of the disposal container is affected by the structural stresses imposed by the handling and disposal operations, and by deterioration from corrosion in the disposal environment.

4075 (PNL—2954) **Tests for determining impact resistance and strength of glass used for nuclear waste disposal.** Bunnell, L.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 41p. Dep. NTIS, PC A03/MF A01.

Tests are described for determining the impact resistance (Section A) and static tensile strength (Section B) of glasses containing simulated or actual nuclear wastes. This report describes the development and use of these tests to rank different glasses, to assess effects of devitrification, and to examine the effect of impact energy on resulting surface area. For clarity this report is divided into two sections, Impact Resistance and Tensile Strength.

4076 (SAND—79-0172) **Defense high-level waste and spent fuel characterization for geologic waste repositories.** Sutherland, S.H.; Bennett, D.E. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 32p. Dep. NTIS, PC E04/MF E04.

Results of SANDIA-ORIGEN calculations are given for the total thermal output and radionuclide content, up to 100,000 years decay time, for defense high-level waste expected from the Savannah River Plant, the Hanford Reservation and the Idaho National Engineering Laboratory, and for one pressurized water reactor and five boiling water reactor spent fuel types. These results are expected to be of value in evaluating the potential for storing defense high-level waste and/or spent fuel in geologic waste repositories.

4077 (SAND—79-0981C) **Tracer tests performed in the field for WIPP in southeastern New Mexico.** Gonzalez, D.D.; Hill, L.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 3p. (CONF-791112—19). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

A two-well recirculating tracer test began in October, 1979, to define as accurately as possible the hydraulic character of a fractured carbonate aquifer, the Culebra dolomite member of the Rustler Formation at the WIPP site in Eddy and Lee Counties, New Mexico. The Culebra dolomite overlies a zone planned for isolation of transuranic contaminated waste generated by the United States defense programs. The storage zone of the proposed facility is in nearly pure halite and about 1400 feet (427 meters) below the Culebra dolomite, the most likely pathway for the migration of radionuclides to the biosphere in the event the repository is breached by groundwater. Included in the definition of the hydraulic character of the Culebra aquifer are natural groundwater velocities, aquifer porosity and components of dispersivity. The proposed tracer test using sodium benzoate, a homologous series of chlorofluoromethanes and pentafluorobenzoic acid as tracers is described. Results of the test will be reported at a later date.

4078 (SAND—79-1000C) **Thermal aspects of waste emplacement in layered tuffs.** Bulmer, B.M.; Lappin, A.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-791112—2). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

The thermal response of layered tuffs in Yucca Mountain at NTS to radwaste emplacement at 711 m depth (Bullfrog tuff) was analyzed. Three in-situ boiling criteria were examined. No boiling is predicted for any burial depth with power densities up to 150 kW/acre. Allowable powerdensities are plotted vs depth below 711 m for both HLW and spent fuels. (DLC)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 4061, 4062, 4776, 4795, 4995, 4996

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 4063, 4066, 4067, 4514, 4516, 4774, 4782, 4783, 4784, 4853, 4854, 4857, 4864

4079 (LA-UR—79-2781) **Nondestructive assay instrument for measurement of plutonium in solutions.** Shirk, D.G.; Hsue, F.; Li, T.K.; Canada, T.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-791049—14). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A nondestructive assay (NDA) instrument that measures the ^{239}Pu content in solutions, using a passive gamma-ray spectroscopy technique, has been developed and installed in the LASL Plutonium Processing Facility. A detailed evaluation of this instrument has been performed. The results show that the instrument can routinely determine ^{239}Pu concentrations of 1 to 500 g/l with accuracies of 1 to 5% and assay times of 1 to 2 x 10^3 s.

4080 (NTIS/PS—79/0305) **Nuclear materials safeguards. Volume 2. 1975-1977 (a bibliography with abstracts). Report for 1975-1977.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 259p. NTIS PC N01/MF N01.

Citations cover the methods of safeguarding nuclear materials through effective management, accountability, nondestructive assays, instrumentation, and automated continuous inventory systems. Problem areas and recommendations for improving the management of nuclear materials are included. (This updated bibliography contains 249 abstracts, none of which are new entries to the previous edition.)

4081 (NTIS/PS—79/0306) **Nuclear materials safeguards. Volume 3. 1978-March, 1979 (a bibliography with abstracts). Report for 1978-March 1979.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 237p. NTIS PC N01/MF N01.

Citations cover the methods of safeguarding nuclear materials through effective management, accountability, nondestructive assays, instrumentation, and automated continuous inventory systems. Problem areas and recommendations for improving the management of nuclear materials are included. (This updated bibliography contains 230 abstracts, all of which are new entries to the previous edition.)

4082 (NUREG/CR—0935) **Transient shipment rule value-impact analysis.** Fraley, D.W.; Chockie, A.D.; Levy, M.; Kofoed, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 139p. Dep. NTIS, PC A07/MF A01.

This document presents an analysis of alternatives under consideration by the US Nuclear Regulatory Commission for the protection of transient shipments of Strategic Special Nuclear Material (SSNM). (A transient shipment is a shipment of SSNM from one foreign country to another which makes a stopover in US territory). The objective of this study was to assess the values and impacts of NRC designated alternatives. Criteria were developed for the evaluation which are based on the NRC's objective of providing physical protection for transient shipments at a level equivalent to that afforded domestic shipments of SSNM. The results of the assessment are intended to provide support to the NRC in their selection of a preferred approach for the protection of transient shipments.

4083 (NUREG/CR—1013) **Use of process monitoring data for the enhancement of nuclear material control and accounting.** Miles, J.C.; Glancy, J.E.; Donelson, S.E. (Mound Facility, Miamisburg, OH (USA)). Sep 1979. Contract EY-76-C-04-0053. 38p. (MLM—2643). Dep. NTIS, PC A03/MF A01.

Two licensed fuel fabrication facilities, one processing low-enriched and the other high-enriched uranium, were examined in this study. Safeguards effectiveness of the current material accounting system at each licensee was quantitatively assessed using an evaluation methodology. Two generations of alternate material control systems using portions of the facilities' process monitoring data were developed and similarly evaluated for each facility.

4084 (SAND—79-1668) **Overview of the software for the Telemation/Sandia unattended video surveillance system.** Merillat, P.D. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

A microprocessor has been used to provide the major control functions in the Telemation/Sandia unattended video surveillance system. The software in the microprocessor provides control of the various hardware components and provides the capability of interactive communications with the operator. This document, in conjunction with the commented source listing, defines the philosophy and function of the software. It is assumed that the reader is familiar with the RCA 1802 COSMAC microprocessor and has a reasonable computer science background.

4085 (UCRL—52793) **Towards unified performance measures for evaluating nuclear safeguard systems: mathematical foundations and formal comparison of existing models.** Corynen, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1979. Contract W-7405-ENG-48. 55p. Dep. NTIS, PC A04/MF A01.

An important step in the analysis of large-scale systems is the development of economical and meaningful measures of system performance. In the literature on analysis of nuclear safeguard systems, many performance measures have been advanced, but their interrelationships and their relevance to overall system objectives have not received attention commensurate with the effort spent in developing detailed safeguard models. The work reported here is an attempt to improve the development and evaluation of performance measures for nuclear safeguard systems. This work falls into three main areas. First, we develop a new framework which provides an initial basis for defining and structuring performance measures. To demonstrate that this framework allows a clear understanding of the purposes of nuclear safeguard systems, we employ it to state various safeguard questions clearly and concisely. The framework reflects the rough subsystem structure of safeguard systems - the detection and response subsystems - and formally accommodates various safeguard models. We especially emphasize two of these models which are under development at Lawrence Livermore Laboratory, the structured assessment approach (SAA) and the systems vulnerability assessment method (SVAM). Second, we examine some performance measures presently used in the nuclear safeguards area and in reliability theory in general. Some of these we accept and modify to obtain system performance measures that are an additive combination of subsystem performance measures, a very convenient form indeed. Others we reject as impractical and meaningless. Finally, we determine some common features between the SAA and SVAM models by formally comparing these models in our framework.

4086 **Measurement technology for safeguards and materials control.** Farmakes, R. (ed.). La Grange Park, IL; American Nuclear Society, Inc. (1979). 73p.

Summaries of papers on safeguards and materials control technology are presented under the following subject areas: standards and analytical chemistry; national and international inspection; enrichment and fuel fabrication; spent fuel and reprocessing; and integrated material control systems and conceptual safeguards system design. Each summary was processed separately for the Energy Data Base. (HDR)

4087 **Reference materials and measurement traceability: fact vs fiction.** Bingham, C.D. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 1(1979).

4088 **Role of standard reference materials in achieving measurement traceability.** Reed, W.P. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 1-2(1979).

4089 **Preparation of prototype NDA reference materials: a progress report.** Voeks, A.M.; Trahey, N.M. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 2-3(1979).

4090 **Analytical data for practical safeguards: performance and evaluation of international intercomparison programs.** Beyrich, W.; Spannagel, G. (Kernforschungszentrum, Karlsruhe, Germany). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 4-5(1979).

4091 **Safeguards reference measurement system utilizing resonance neutron radiography.** Schrack, R.A.; Behrens, J.W.; Bowman, C.D.; Carlson, A.D. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 7-8(1979).

4092 **LASL analytical chemistry program for fissionable materials safeguards.** Jackson, D.D.; Marsh, S.F. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 11-12(1979).

4093 Low-level uranium determination by constant current coulometry. Mitchell, W.; Lewis, K. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 12(1979).

4094 Application of a direct method for the determination of trace uranium in safeguards samples by pulsed laser fluorometry. Collins, L.H.; Zook, A.C. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 12-13(1979).

4095 Automated ion-exchange system for the rapid separation of plutonium from impurities in safeguards analyses. Freeman, B.P.; Weiss, J.R.; Pietri, C.E. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 13-14(1979).

4096 Measurement requirements and experience in international safeguards. Thorne, L.; Ramalho, A. (International Atomic Energy Agency, Vienna, Austria). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 17(1979).

4097 Inventory verification methods in DOE safeguards inspections. Inlow, R.O. (Dept. of Energy, Albuquerque Operations Office, NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 17-18(1979).

4098 Safeguards independent measurements program. Martin, W.G. (Nuclear Regulatory Commission, King of Prussia, PA). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 18(1979).

4099 Rapid inventory taking. Marsden, P.S.S.F. (United Kingdom Atomic Energy Authority, Oxon, England). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 20(1979).

4100 New nonintrusive spent-fuel inventory confirmation technique. Dowdy, E.J.; Nicholson, N.; Caldwell, J.T. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 22-23(1979).

4101 Study of gamma-ray spectroscopy for spent-fuel verification at the Bruce CANDU reactors. Lipsett, J.J.; Irvine, J.C.; Williams, W.J. (Atomic Energy of Canada, Ltd., Ontario). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 36(1979).

4102 Gamma spectrometric measurements of LWR power reactor spent fuel. Kupryashkin, V. (International Atomic Energy Agency, Vienna, Austria); Haginoya, T.; Poroykov, V.; Dragnev, T.; Damjanov, B. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 38-40(1979).

4103 Determination of some characteristics of LWR spent fuel by alpha spectrometry. Zelenkov, A.G.; Pirozhkov, S.V.; Rodionov, Yu.F.; Shvetsov, I.K. (Kurchatov Inst. of Atomic Energy, Moscow). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 40(1979).

4104 Automated accountability tank calibrator. Baumgarten, G.P.; Cooper, D.; Robertson, B. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 40-41(1979).

4105 In-tank measurement of solution density. Jones, F.E.; Schoonover, R.M.; Houser, J.F. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 42(1979).

4106 Tank volume calibration algorithm. Jones, F.E. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 42(1979).

4107 Analysis of plutonium and uranium by the resin-bead mass spectrometric method. Walker, R.L.; Smith, D.H. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 43(1979).

4108 Demonstration of totally sampled wavelength dispersive XRF for use in the assay of the SNM content of dissolver solutions. Hudgens, C.R. (Monsanto Research Corp., Miamisburg, OH). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 43-44(1979).

4109 Study of a two-detector method for measuring Pu isotopics. Fleissner, J.G.; Lemming, J.F.; Jarvis, J.Y. (Monsanto Research Corp., Miamisburg, OH). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 44-45(1979).

4110 Gamma-ray NDA instrumentation for total plutonium and isotopics in plutonium product solution. Cowder, L.; Hsue, S.T.; Johnson, S.; Parker, J.; Russo, P.; Sprinkle, J. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 45(1979).

4111 Nondestructive, energy-dispersive, x-ray fluorescence analysis of product-stream concentrations from reprocessed nuclear fuels. Camp, D.C.; Ruhter, W.D. (Univ. of California, Livermore). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 45-47(1979).

4112 Experimental ^{233}U nondestructive assay with a random driver. Goris, P. (Westinghouse Electric Corp., Richland, WA). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 47-49(1979).

4113 Measurement of plutonium and americium in molten-salt residues. Haas, F.X.; Lawless, J.L.; Herren, W.E. (Rockwell International, Golden, CO). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 49-50(1979).

4114 Uranium and plutonium assay of crated waste by gamma-ray, singles-neutron, and slow-neutron coincidence counting. Harlan, R.A. (Rockwell International, Golden, CO). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 50(1979).

4115 Evaluation of an x-ray L/sub III/-edge densitometer for assay of mixed uranium-plutonium solutions. Mosley, W.C. (Savannah River Lab., Aiken, SC); Thompson, M.C.; Reynolds, L.W.; Russo, P.; Canada, T.R.; Langner, D.G. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 50-52(1979).

4116 Goals of measurement systems for international safeguards. de Montmollin, J.M. (Sandia Labs., Albuquerque, NM); Weinstock, E.V. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 53(1979).

4117 Evolution of safeguards systems design. Dietz, R.J. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 53-54(1979).

4118 Sensitivity analysis of the MUF variance with respect to the measurement system performances on a large HEU fabrication plant. Argentesi, F. (Commission of the European Communities, Varese, Italy); Cullington, G. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 54-55(1979).

4119 Monte Carlo simulation of MUF distribution for application to Euratom safeguards. Argentesi, F.; Franklin, M. (Commission of the European Communities, Varese, Italy). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 55-56(1979).

4120 Dynamic materials accounting for solvent-extraction systems. Cobb, D.D.; Ostenak, C.A. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 58(1979).

4121 Materials accounting considerations for international safeguards in a light-water reactor fuels reprocessing plant. Hakkila, E.A.; Cobb, D.D.; Dayem, H.A.; Dietz, R.J.; Kern, E.A.; Shipley, J.P. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 58-59(1979).

4122 Study of the application of semidynamic material control concept to safeguarding spent-fuel reprocessing plants. Ikawa, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki, Japan); Ihara, H.; Sakuragi, H.; Nishimura, H.; Hirata, M.; Iwanaga, M.; Suyama, N.; Matsumoto, K. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 59-60(1979).

4123 Safeguards system of back-end facilities with emphasis on waste management. Akimoto, Y. (Mitsubishi Metal Corp., Tokyo, Japan); Ishii, T.; Yamagami, S.; Shibata, T. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 60-61(1979).

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

4124 (UCRL—15113) **Fabrication and characterization of cryogenic targets for inertial confinement fusion.** Rieger, H.; Kim, K. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). Aug 1979. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

A new technique has been developed which is capable of fabricating uniform cryogenic targets for use in inertial confinement fusion. The essence of the technique is to directly wet a target with a cold helium gas jet, which results in freezing of the DT mixture contained in the target. A controlled amount of current is pulsed through a heater wire surrounding the target, giving rise to fast evaporation and refreezing of the DT-condensate into a uniform layer. Experiments, which have been performed with D_2-filled glass microshells, successfully produce uniform layers of both liquid and solid D_2 inside the glass shells. A set of data illustrating the technique is presented and analyzed.

PHYSICAL ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 4789, 4790

HYDROGEN

4125 IGT research experience in hydrogen energy systems. Chicago, IL; Institute of Gas Technology (1979). 14p. (NP—24029).

IGT's hydrogen energy research experience and their thermochemical hydrogen production research are discussed briefly. A chronology of IGT's hydrogen energy research program is given.

PRODUCTION

THERMOCHEMICAL PROCESSES

4126 (JPL-PUB—79-81) **Potential heat exchange fluids for use in sulfuric acid vaporizers.** Lawson, D.D.; Petersen, G.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Oct 1979. Contract ET-78-I-01-3112. 14p. Dep. NTIS, PC A02/MF A01.

A series of liquids have been screened as candidate heat exchange fluids for service in thermochemical cycles for hydrogen production that involve direct contact of the fluid with sulfuric acid and vaporization of the acid. The required chemical and physical criteria of the liquids are described and the results of some preliminary high temperature test data are presented.

4127 (KFK—2809) **Present status of research in hydrogen production from water by thermochemical cycles.** Filby, W.G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Apr 1979. 30p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A brief discussion of the necessity of new fuel production methods for a future hydrogen energy system is followed by an outline of currently available alternatives. Of these only methods using fossil sources will be economically viable in the near and midterm. Thermochemical methods, employing theoretically only water and heat will only become competitive in the long range after depletion of fossil raw materials has further advanced. A detailed discussion of currently favored thermochemical cycles closes the report.

4128 (LA-UR—79-2799) **LASL thermochemical hydrogen status on September 30, 1979.** Cox, K.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791127—1). Dep. NTIS, PC A02/MF A01.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The work described in this report was accomplished during the period October 1, 1978 to September 30, 1979. Most of the effort was applied to a study of the Los Alamos Scientific Laboratory (LASL) hybrid bismuth sulfate cycle. The work included a conceptual design of the cycle and experimental work to verify the design conditions. Key findings were: a 50.8% efficiency was obtained when an improved cycle design was coupled to a fusion energy source at 1500 K; experimental results showed an endothermic heat requirement of +172 kJ/mol for the decomposition of $Bi_2O_3.2SO_3$ to $Bi_2O_3.SO_3$, and SO_3; reaction times for bismuth sulfate decomposition were determined as a function of temperature. At 1240 K, < 1.5 min were required for the first two stages of decomposition from $Bi_2O_3.3SO_3$ to Bi_2O_3; tests made to determine the feasibility of decomposing $Bi_2O_3.2SO_3$ in a 1 inch diameter rotary kiln showed that $Bi_2O_3.2SO_3$ could be decomposed continuously. In related work, support was given to the DOE Thermochemical Cycle Evaluation Panel (Funk). The Second Annual International Energy Agency (IEA) Workshop on Thermochemical Hydrogen Production from Water met on September 24 to 27, 1979 at Los Alamos.

COAL GASIFICATION

REFER ALSO TO CITATION(S) 3985

STORAGE

4129 (NTIS/PS—79/0581) **Hydrogen storage. part 1. storage as a gas or liquid (a bibliography with abstracts). Report for 1974-May 79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 133p. NTIS PC N01/MF N01.

The bibliography references aspects of storing hydrogen as a liquid or a gas. Citations cover fuel storage, energy storage, and the construction of tanks used to store the material. Any type of storage that is related to batteries fuel cells or solar cells unless the abstract states that its purpose is to store hydrogen are excluded. (This updated bibliography contains 126 abstracts, 14 of which are new entries to the previous edition.)

CHEMISORPTION

4130 (NTIS/PS—79/0582) **Hydrogen storage. part 2. hydrogen as a hydride (a bibliography with abstracts). Report for 1974-May 79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 128p. NTIS PC N01/MF N01.

The bibliography covers hydrogen storage as a hydride. Citations discuss the chemical and physical properties of the hydride and how useful it will be for hydrogen storage. References also cover the conversion of hydrogen to a hydride and the conversion back to hydrogen. (This updated bibliography contains 121 abstracts, 14 of which are new entries to the previous edition.)

TRANSPORT

4131 Suitability of gas distribution equipment in hydrogen service. Jasionowski, W.J.; Johnson, D.G.; Pangborn, J.B. Chicago, IL; Institute of Gas Technology (1979). 5p. (CONF-790803—61).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

An experimental study was conducted with contemporary gas distribution equipment in hydrogen service. Observations and results with 3 test loops initially operated on natural gas (baseline) and then on hydrogen for 6 months indicate no incompatibilities in performance. Existing in-place components and piping with the possible exception of meters should be adequate for hydrogen delivery. The observed overall hydrogen-to-natural-gas leak ratio was about 3.25, and the overall energy loss ratio was about 1.04. If piping and operating pressures are not changed, hydrogen energy delivery will be about 80% to 90% of natural gas energy delivery under turbulent flow conditions, and may be only 40% of natural gas energy delivery under laminar flow conditions. Short-term (6 months) exposure to hydrogen in distribution service did not affect the properties of metallic materials of system components; there are indications that some plastic products, some lubricants, and some adhesives were affected by the exposure.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 4131, 4730

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 3965

PREPARATION FROM WASTES OR BIOMASS

4132 (PB—292993) **A pollution-free system for the economic utilization of municipal solid waste, task 9, assessment of purox pilot plant performance.** Schultz, H.W. (Columbia Univ., New York (USA). School of Engineering and Applied Science). 15 Oct 1975. 11p. NTIS PC A02/MF A01.

In an effort to develop a pollution-free system for the economic utilization of municipal solid waste (MSW), the Purox process was investigated. This report presents an evaluation of a pilot plant, constructed by the Union Carbide Corporation in Charleston, West Virginia, for the purpose of introducing the Purox system for the pyrolysis of MSW on a commercial scale. The system is a slagging fixed bed gasifier which employs oxygen to effect a partial combustion of the carbonaceous residue that sifts to the hearth of the shaft furnace. Liberated heat acts as a thermal driving force for the endothermic pyrolysis of solid waste in the mid section of the furnace and for drying and preheating the charge in the upper portion. Of medium heating value, the gas is composed of approximately 50 percent carbon monoxide, 30 percent hydrogen, 15 percent carbon dioxide, and 5 percent hydrocarbons. The report includes a description of the pilot plant, early operating experience, and current operation. Demonstrating the technical feasibility of the process, the results confirm the projections of capacity oxygen demand and product quality. Some minor operational problems remain to be resolved.

4133 (PB—292994) **A pollution-free system for the economic utilization of municipal solid waste, Phase II. Design of an integrated system for the city of New York. Task 3-R, the economics of purox gas utilization.** Benziger, J.B.; Schulz, H.W. (Columbia Univ., New York

(USA). School of Engineering and Applied Science). 15 Oct 1974. 31p. NTIS PC A03/MF A01.

This is a report on work accomplished as part of Phase 2 of a project to design a pollution-free system for the economic utilization of municipal solid waste with emphasis on the conditions and requirements of New York City. It specifically deals with the economics of Purox Gas Utilization in the development of an integrated system. The prime reason given for considering the installation of a Union Carbide Oxygen Refuse Converter (Purox System) is the credits realized from the gas produced during pyrolysis. Advantages of such a system are described in terms of the various uses to which the gas can be diverted. These include utilization of the Purox gas in existing boilers and diversion to gas turbines. The use of gas turbine generation for power generation is well established, but the size of the installation is important in determining costs. Results of a trade-off study made to determine the most economic way of using Purox fuel gas is presented. The report evaluates self-support power generation, costs of gas turbine power generation and gas transmission by pipeline. Included are tables and figures showing evaluation of, investment and operating costs for self support power, gas turbine specification and selection, and investment and operating costs for gas turbine installation.

PREPARATION

REFER ALSO TO CITATION(S) 3980

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 3965, 3979

PREPARATION FROM WASTES OR BIOMASS

4134 (CONF-780895—1) **Chemicals and fuels from papermill sludges.** Emert, G.H. (Gulf Oil Chemicals Co., Shawnee Mission, KS (USA)). 1978. 12p. TIC.

From NCASI Southern regional meeting; Atlanta, GA, USA (2 Aug 1978).

A brief overview is given of Gulf Oil's biochemical research program on the production of ethanol from cellulose. In the Gulf process the cellulose is saccharified to glucose by enzymatic hydrolysis and the glucose fermented by yeasts to ethanol and CO_2 in one reaction vessel. A comparison of saccharification alone with the combined process shows that the removal of the saccharification products by the immediate action of the yeast enhances the glucose production. Because of the success of the pilot plant operation, plans are underway for a demonstration plant. The economics are briefly summarized. (JSR)

INORGANIC HYDROGEN COMPOUND FUELS

4135 (AD-A—065046) **Amine fuels via the urea process. Technical report, 19 April 1976-19 September 1977.** Gray, A.; Fochtman, E. (IIT Research Inst., Chicago, IL (USA)). May 1978. Contract F04611-76-C-0043. 235p. NTIS PC A11/MF A01.

The distinct possibility that hydrazine fuels would not be available in the quantities required by Air Force and NASA during the late 1970's and early 1980's motivated the Air Force to support research on alternative processes which would have the potential of minimum environmental impact. This is a report of the study of the production of MMH (monomethyl hydrazine) and UDMH (unsymmetrical dimethyl hydrazine) via the urea process. Primary effort of the program was devoted to the study of the chemistry of the reactions. Engineering design data were developed for several of the unit processes and have permitted a preliminary process design and economic evaluation. Additional engineering data will be required to design a pilot plant.

HYDRO ENERGY

REFER ALSO TO CITATION(S) 4465, 4466

PLANT DESIGN AND OPERATION

4136 (PB—295346-T/SL) **Water power and construction of complex hydraulic works during fifty years of Soviet rule.** Yurinov, D.M. (Department of the Interior, Washington, DC (USA)). [nd]. Translation of Gidroe'nergetika i Kompleksnoeoi Vlasti, Moscow, 1969. 609p. NTIS PC A99/MF A01.

The first section concerns developments and improvements in the construction of hydro plant installations, the manufacture and improvements of the basic power equipment of hydro power plants, and developments in the constructional techniques of hydro structures and hydraulic components. Articles on the importance of hydro power construction to the natonal economy and future prospects of growth of water power exploitation round off this section. The second section concerns the exploitation of the Volga-Kama and the Angara-Enisei cascades of hydro power plants, the construction of network of deep waterways in the Europea part of the USSR, and information on water management problems of industrial regions and overall utilization and conservation of the water resouces of the USSR. Some of the problems of special interest dealt with in this section relate to hydro power development in the Far North, the power and irrigation systems of the Central Asian republics, hydro power installations in the Transcaucasian regions and hydro power plant construction on the rivers of the Ukrainian and Moldavian SSRs. Of equal interest are the problems related to a change in the flow of the northern rivers. The third section consists of articles devoted to very large hydro power plants.

ENVIRONMENTAL ASPECTS

4137 (CONF-791056—2) **Analysis of environmental impacts of water level fluctuation in reservoirs at hydroelectric sites.** Szluha, A.T.; Loar, J.M.; Turner, R.R.; Hildebrand, S.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Waterpower 79 international conference: small scale hydropower; Washington, DC, USA (1 Oct 1979).

Potential significance, on a site-specific basis, of water-level-fluctuation impacts ranges from benign (run-of-the-river plants) to possibly significant enough to require mitigation. It is emphasized that efforts to develop small hydroelectric sites that entail water-level fluctuation should include a careful analysis of the types of impacts. The potential significance of these impacts should be evaluated as an integral part of initial studies of site feasibility.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 4554

4138 (MTR—7971) **Solar information outreach strategies and action plans. Final report.** Hewett, R. (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1978. Contract EG-77-C-01-4041. 180p. Dep. NTIS, PC A09/MF A01.

Solar information outreach action plans are information-oriented technology transfer programs designed to facilitate solar commercialization in concert with other programs - tax incentives, load guarantees, etc. Strategies are logical groupings of action plans which focus on specific solar markets. Action plans are generally aimed at addressing important solar-related concerns and needs of key decision makers and other strategic participants that have major roles in solar commercialization. As such, action plans fall into three categories: those that span all or several markets, those that are market specific and those that relate to program management. This report recommends 26 action plans logically structured into five solar information outreach strategies. For each action plan, it identifies action plan activities, the rationale behind them and procedures for implementation.

4139 (SERI/TP—49-186, pp 15-18) **Roles of the trade associations.** Butt, S. (Solar Energy Industries Association, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The Solar Energy Industries Association is a typical trade association, trying to do the things that a group of people related by their business may best do together in order to enhance their individual profitability. Its foreign and domestic objectives are discussed. The new industry is faced with unique opportunities to develop new and innovative measures, methods, and relationships; these can be measures of cooperation between industry and government. It is felt that the US solar industry receives much less marketing assistance from the government than foreign companies receive from their governments, but the author does specify some advantages, and notes that with the development of innovative methods that differ from those of the French and Japanese, means will be provided to become competitive in the international market. (MCW)

4140 (SERI/TP—49-186, pp 19-23) **Overview: Department of Energy.** Corcoran, W. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

A general national plan for the acceleration of the commercialization of solar energy within the DOE involves programs on hot water, passive, industrial process heat, photovoltaics, wood, and wind. An overview of the US government interests and activities in stimulating technologies that are ready for the marketplace and those where cooperative research programs are mutually beneficial include solar thermal systems, photovoltaics, wind energy conversion, biomass, ocean thermal, and lowhead hydro. International activities are emphasized and these include commercialization, technical cooperation, and cooperation with developing countries. Three slides are used: Scope of Federal Interest, Multi-national organizations, Department of Energy's International Solar Energy Role to illustrate the presentation. (MCW)

4141 (SERI/TP—49-186, pp 155-166) **Advanced energy programs.** Hellhake, G.P. (General Electric Co., Philadelphia, PA). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

In order to discuss the General Electric advanced energy programs, slides were used. Company components consist of the R and D Center, Study Center, and Product and Advanced Energy Departments. Advanced energy programs include solar, wind, photovoltaic, and nuclear. International activities in the Advanced Energy Department include activities in Spain, Western Europe, and the Mideast. (MCW)

4142 **SOLTECH '78 conference proceedings.** London, England; UK-ISES (1978). 169p. (CONF-7804126—). UK-ISES, 19 Albemarle St., London W1X 3HA, England.

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

The twenty papers were entered in the data base separately. The proceedings also include abstracts of 24 contributed papers. (WHK)

4143 **Role of the Arab countries of the Gulf in developing solar energy.** Kanoo, A.L. (Ministry of Housing, Bahrain, Bahrain). pp 3-5 of SOLTECH '78 conference proceedings. London, England; UK-ISES (1978).

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

The potential and importance of solar energy utilization are discussed, and present and planned activities of the Arabian countries in the Gulf region in solar energy development are mentioned. (WHK)

4144 **Solar power for developing countries.** Dunn, P.D. (Univ. of Reading, England). pp 84-88 of SOLTECH '78 conference proceedings. London, England; US-ISES (1978).

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

Figures are given for wood and dung as a factor in world energy use - about 8%. The energy input and use in the Sudan and the USA are tabulated. Possibilities for the future uses of solar energy are listed. (MHR)

4145 **Solar energy technology and applications in the United States.** Herwig, L.O. (Dept. of Energy, Washington, DC). pp 127-137 of SOLTECH '78 conference proceedings. London, England; US-ISES (1978).

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

The US solar energy RD and D program is reviewed. Direct thermal applications include domestic and commercial water heating, heating and cooling of buildings, and agricultural and industrial process heat systems. The solar electric program includes solar thermal power, wind power, photovoltaic systems, and ocean thermal power systems. The fuels from biomass program is also discussed. The solar energy budget for FY 1977 and the appropriated budget for FY 1978 are given. (WHK)

4146 **Solar heating and cooling experiments at the Joint Research Centre-Ispra of the European Communities.** Aranovitch, E.; Ledet, M.; Roumengous, C.; van Asselt, D. (Commission of the European Communities, Ispra, Italy). pp 725-736 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An overall view is given of research center activities with some illustrative examples. The following are covered: measurements and analysis of solar data, high efficiency collectors, and system studies. (MHR)

RESOURCES AND AVAILABILITY

4147 (CONF-780983—, pp 445-446) **Solar-climatic statistical study.** Bray, R.E. (Northrop Services, Inc., Huntsville, AL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this study is to derive, from historical data available at 26 SOLMET stations recording on an hourly basis, frequencies and probabilities of specific levels of solar insolation and wind power occurring and persisting for up to one week. These empirical probabilities will be determined for average daily insolation and average daily wind power, on a monthly basis, considered independently or in combination.

4148 (LBL—9412) **Application of circumsolar measurements to concentrating collectors.** Grether, D.F.; Evans, D.; Hunt, A.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 6p. (CONF-790541—58). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A systematic measurement program is being carried out to assess the effects of circumsolar radiation (the solar aureole) on the performance of solar conversion systems using concentrating collectors. Four instrument systems have been constructed and are providing detailed intensity vs. angle profiles of the solar and circumsolar (out to 3^0 from the center of the sun) as well as other solar measurements. The instruments are briefly described. Results are presented of the average effect of the circumsolar radiation on the solar energy available to an idealized point focusing system. Results are also presented for an analysis of two specific Central Receiver designs.

ECONOMICS

4149 (SERI/TP—49-186) **DOE/solar export opportunities workshop.** (Department of Energy, Washington, DC (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1979. Contract EG-77-C-01-4042. 195p. (CONF-790121—). Dep. NTIS, PC A09/MF A01.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The workshop was conducted to bring together persons from government agencies and the US solar industry to initiate dialogue needed to create and implement programs facilitating the export of US solar technology, hardware, and services. A separate abstract was prepared for 23 individual presentations, all of which will appear in Energy Research abstracts (ERA) and Energy Abstracts for Policy Analysis (EAPA).

4150 (SERI/TP—49-186, pp 27-29) **Activities of the Department of Commerce.** Garnitz, R. (Dept. of Commerce, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

Mr. Garnitz summarizes briefly the activities of DOC in assisting US manufacturers in selling their products abroad - with particular interest in new industries and new markets. He relates briefly their activities relating to solar equipment, particularly large exhibits. He also mentions that any new product, at no cost to the individual company, can be included in DOC's Commercial News which goes abroad to some 60 countries.

4151 (SERI/TP—49-186, pp 31-35) **Overview of the activities of the Export-Import Bank.** Bierman, J. (Export-Import Bank, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

An amendment to the Export-Import Bank Act required the Bank to designate an officer to advise the Bank President and the Congress what the Bank was doing for the renewable energy industry and to establish programs and incentives that would allow support of the solar industry. How the programs of the Bank may be used by the solar industry in support of its export efforts is explained and then the Bank, the institution, and the programs are described. (MCW)

4152 (SERI/TP—49-186, pp 37-39) **Activities of the Agency for International Development.** Klein, S. (Dept. of State, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The Agency for International Development supports assistance programs directed towards poorer elements in developing countries. But the ways that it may help in the private sector are pointed out. Presently, a prime objective of the Agency is to help developing countries with renewable energy source development, and solar energy, in particular, will be examined. The challenge is to develop systems that are cost-competitive, can be maintained, and have low recurrent costs. The Agency is now attempting to structure its assistance programs to demonstrate some of the renewable technologies. Regional bureaus of AID include Africa, Near East, Asia, Latin America, the Caribbean, and a central bureau in Washington (The Development Support Bureau). (MCW)

4153 (SERI/TP—49-186, pp 41-44) **Activities of the Agency for International Development.** Bosken, J. (Agency for International Development, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The Agency for International Development manages the US foreign assistance program conducted under the guidance of the Department of State. Four main concerns of the program are: the national security of the US; the broader diplomatic goal of maintaining good relations with other countries; the economic development of the world as a whole and the maintenance of a strong US economy; and humanitarian concerns based on the unwillingness of the US to accept worldwide poverty. The economics of the US and developing countries is contrasted and compared. The programs of AID are discussed, emphasizing photovoltaics regarding direct solar technology. Aid currently conducting a project in Upper Volta that will prove the technical feasibility of the use of photovoltaics in remote areas of developing countries. (MCW)

4154 (SERI/TP—49-186, pp 121-123) **Energy related activities of the World Bank.** Riley, V.J. (World Bank, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The World Bank is an international organization, a specialized agency of the United Nations. It finances projects in developing countries in Asia and Latin America, in agriculture and infrastructure, power generation and distribution, and industry. Many solar technologies are already well established (use of biomass, wind energy systems, direct use of solar power) and the development and application of some other techniques that are, or have the potential of becoming economic in the near or medium term are investigated. These include solar pumps, solar electric power, and other devices capable of playing a role in the developing world - particularly devices with potential as a decentralized source of energy on farms and in small communities in rural areas. Some specific programs being undertaken are cited. (MCW)

4155 (SERI/TP—49-186, pp 131-145) **Small business case study.** Neuner, G. (Acurex Corp., Mt. View, CA). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

Some facts about Acurex corporation dealing with its photovoltaic and international programs are presented in a slide presentation covering the following: Acurex capabilities, activities, international experience; IEA project; essential international business elements; problem areas; business relationships; national pride; communications; monetary constraints; cost of doing overseas business; characteristics of a small business.

4156 (SERI/TP—49-186, pp 167-176) **Roles and recommendations.** Willis, R.W. (Solenergy Corp., Wakefield, MA); Day, J.; Curcurullo, M.; Belanger, M.; Schlesinger, J.P. Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

Five reports are presented on roles and recommendations as discussed in workshop groups. Subjects covered pertained to assessment, communications, promotion, financial aid, and the last role dealt with a question such as what is the role of DOE/SERI and DOC to promote export of solar. Summaries of these discussions are presented.

4157 **Economic and social implications of solar energy.** Rabinovitz, R.; Kreith, F. (Univ. of Colorado, Boulder). pp 715-723 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Various energy wastes are reviewed. The need to match energy sources and the tasks to be performed are discussed. The impact of change caused by developing technologies is explored.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 4149, 4157, 418 & 4206

4158 (COO—4546-12) **Legal aspects of financing solar-heated residential structures. Final report of Innovative Research Program Subtask, December 1977-September 1978.** Hiller, R.L. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 66p. Dep. NTIS, PC A04/MF A01.

Through both interviews with primary and secondary mortgage market lending institutions and a search of the relevant literature, the major concerns and attitudes of financial institutions toward solar homes are reviewed, unique problems encountered in making loans on such structures are discussed, and special requirements placed upon solar home loans are explored. At present, these are seen as centered around: (1) placing an appropriate valuation on a solar-heated home, (2) assessing the technical feasibility of a solar energy system, and (3) determining what energy savings might accrue through installation of a solar energy system and how such savings can best be integrated into the lending process. Some of the most pertinent literature on this subject is reviewed and the goals to be strived for in protecting solar access are set forth. Negative solar easements and restrictive covenants are seen as the most appropriate legal tools for assuring adequate solar access. Seven elements which must be addressed when describing the air space to be protected by an effective easement or covenant are identified. Appendices are included which show how one innovative lending institution has developed a policy for financing solar homes based upon these elements. Problems with regard to obtaining title insurance are discussed, and the enforceability and transferability of solar access rights are detailed.

4159 (SERI/TP—49-186, pp 5-9) **Policy implications of solar export activities.** Jackson, S. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The US has a large commitment to solar energy and exerts a powerful demonstration effect on other countries. Competition among industrial countries, if channeled into constructive avenues, can help speed the development and introduction of solar technologies, both at home and in the developing countries. The US is planning to intensify activities in the following areas: cooperative research and development with technically advanced or capital-surplus developing countries; research and development in energy systems for LDC markets; cooperative analyses of energy needs, resources, and uses with developing countries; and commercialization of suitable, especially renewable energy technologies. The US needs to temper its zeal to spread solar technologies until the real potential of solar energy is known - until we begin installing and demonstrating systems in developing as well as industrialized countries.

4160 (SERI/TP—49-186, pp 11-14) **Solar on the move: despite DOE.** Ottinger, R. (House of Representatives, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

Solar energy was to receive about 3% of the DOE budget for FY 1979, a reduction from the previous budget. Rep. Ottinger feels that congressional efforts and public opinion support the desire to implement solar energy, but that the Administration is failing to make much commitment or show any enthusiam for solar development. The few financial incentives and tax credits that do exist are described. What needs to be done are: to help the American people understand what has happened in the past with the development of energy in this country - and the dismal record of our government in promoting solar technologies - as well as the great and real solar potential that exists and to have a Federal policy committed to solar. A report by the Interagency Task Force (Domestic Policy Review on Solar Energy) contains options that could result in business as usual for solar energy (contributing only 10% of the nation's energy needs by 1985) or it could contribute more than 25% placing us on a path for a society whose dominant form of energy will come from the sun.

4161 (SERI/TP—49-186, pp 25-26) **Activities of the Department of State.** Prochnik, M. (Department of State, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

In DOS relations and associations with other countries, the greatest priority is given to those relationships that bear on our national security - both military and economic. Examples touching on solar energy are used to discuss the activities. With the search on

for alternatives to nuclear, solar falls in the category of having a long-term, strong impact. Energy cooperation, and specifically energy technology cooperation with other countries, will have an impact on the need of the industrialized work, and the developing countries as well, to import their oil and gas supplies from sources that may not be very secure. US multilateral and bilateral solar programs are briefly noted. (MCW)

4162 (SERI/TP—49-186, pp 45-60) **Overview of DOE solar cooperative international arrangements.** Vanderryn, J. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

An overview of DOE solar cooperative international arrangements is discussed using slides. Facts on DOE solar international cooperation (multilateral and bilateral cooperation); CCMS solar energy pilot study; IEA solar program; implementing agreement for a program to develop and test solar heating and cooling systems; implementing agreement for a program of research and development on wind energy conversion systems; implementing agreement on large-scale wind energy conversion systems; implementing agreement on the establishment of a project on small solar power systems; implementing agreement for a program of research, development, and demonstration for forestry energy; IEA implementing agreement for a program of research and development on wave power; implementing agreement for the establishment of the biomass conversion technical information service; and bilateral agreements and programs are given. (MCW)

4163 (SERI/TP—49-186, pp 61-72) **Report of the domestic policy review international panel.** Vanderryn, J. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The organization of the Domestic Policy Review panel is first shown on a slide, followed by information on the task of the interantional panel (international market potential for US, potential financial support from international and regional lending institutions for LDC (lesser developed countries) solar development, benefits of existing and potential bilateral and multilateral solar research and development projects, extent to which US solar expansion abroad may benefit US balance of trade and stimulate domestic market, foreign policy implications, barriers to market entry for foreign firms and products into the US); stated foreign policy goals; proposed DPR initiatives (commercialization, technical cooperation, and cooperation with developing countries). (MCW)

4164 (SERI/TP—49-186, pp 73-93) **Cooperative agreements as benefits to US industry.** Herwig, L. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

To discuss cooperative agreements as benefits to US industry, the following slides were used in the presentation: DOE international activities; types of international cooperative activities; international cooperation in research and development questions; summary of international solar cooperative research and development projects; IEA small solar thermal power systems; US/Saudi Arabia solar agreement; US/Spain, US/Italy, and US/Israel solar project activities; industrial benefits of research and development cooperation; overseas export/manufacturing phases; industrial approaches to international solar projects (broad options for government involvement); industrial approaches to overseas commercial activities; risks in overseas commercialization activities; photovoltaics international developments; Federal photovoltaics program (international aspects); international guidebook of solar technologies; catalog of available solar technologies; criteria for catalog listing; SERI contacts for international agreements. (MCW)

4165 (SERI/TP—49-186, pp 95-111) **Commercialization activities: International Solar Commercialization Working Group (ISCWG).** Corcoran, W.L. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

Foreign market surveys and application studies done in cooperation with DOC are some of the activities of the ISCWG. Another activity is information dissemination; another step is to inform foreign organizations and consumers about US solar products and services. The information process includes trade missions, shows, and seminars. Standardization will aid in worldwide consumer acceptance of solar products in competition with other developed countries. Marketing opportunities in some foreign countries are reviewed. With respect to early commercial potential of solar technologies there was greatest interest in photovoltaics for decentralized and relatively low power applications from watts to a few kilowatts. Slides were included to summarize the presentation. (MCW)

4166 (SERI/TP—49-186, pp 177-181) **Issues identified by the solar industry at the DOE/solar export workshop.** Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The workshop achieved a goal of initiating a meaningful dialogue between the US solar industry and US government agencies. Important problems identified at discussion sessions are summarized dealing with the following issues: assessment, promotion, communications, financial aid, and roles various agencies play to promote export of solar. The principal issues arising from the Workshop have been re-cast for convenience into the major categories: information; financial and promotional assistance; industry input; technology transfer, patents, and licensing issues; and an extraordinary effort. (MCW)

4167 **Draft environmental impact report. Staff report.** Sacramento, CA; California Energy Commission (1978). 155p. (NP—24100). California Energy Commission, 1111 Howe Ave., Sacramento, CA 95825.

The following are included: project description, project setting, project impacts, unavoidable adverse impacts, alternatives, growth inducing impacts, cumulative impacts, and the relationship between local short term uses of man's environment and the maintenance of long term productivity. (MHR)

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 4134

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 4409

4168 (AD-A—065009) **High efficiency solar panel (HESP-ii). Final technical report, August 1977-June 1978.** Stella, P.M.; Uno, F.M.; Thornhill, J.W. (Spectrolab, Inc., Sylmar, CA (USA)). Aug 1978. Contract F33615-77-C-3108. 74p. NTIS PC A04/MF A01.

The objective of this program is to develop space qualified weapon survivable silicon solar cells having a BOL conversion efficency of 16% at 25 C under AMO illumination. After seven (7) years in the synchronous orbit environment (approximately 3 x 10^{14} 1 MeV electrons/square centimeter equivalent irradiation) the cells shall not degrade more than 13% in conversion efficiency. The status of the work at this point and the performance of the most recent state-of-the-art cells delivered as representative samples are reported. The results obtained to date indicate that some of the processes chosen for optimization have not proven as fruitful as orginally anticipated, while others have demonstrated marked success. The task now is to integrate these various optimizations into an integrated sequence to fabricate cells that meet or surpass the requirements. A list of possible additional investigations, which appear pertinent and useful to this effort, is included in the section entitled Recommendations.

4169 (DOE/ET/23034—T1) **Amorphous Si solar cells. Second quarterly report, April 1-June 30, 1979.** Dalal, V.L. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Aug 1979. Contract AC03-79ET23034. 56p. Dep. NTIS, PC A04/MF A01.

The objectives of the program are to study and improve properties of plasma deposited a-Si and to design, manufacture and analyze a-Si devices. The accomplishments during the second quarter are: (1) material growth: (a) reproducible, stable, films can be grown from SiH_4 plasma. Films are generally free of pinholes or structures; (b) doping studies of n and p type have started; (c) films containing F have been grown from (H_2 + SiF_4) mixture; (2) material characterization: (a) field effect measurements of intergap state densities have been started. A computer program to correctly analyze field effect measurements has been developed; (b) absorption studies show that a-Si:F,H films can have a higher bandgap, and that bandgap can be changed by varying H:F content in the plasma; (c) studies of activation energy of conductivity have started. They show that n-doped a-Si:F,H films can have very high conductivities [~ 10 $(\Omega\text{-cm})^{-1}$] and very low activation energies (0.023 eV); (d) photoluminescence efficiency has been measured, and found comparable to the efficiency of RCA films; (e) infrared absorption data shows that H is mainly bonded as Si:H and not as $Si:H_2$; and (3) device design: (a) an analysis of a-Si devices has been completed. The analysis shows that even with limited diffusion length (0.1 μm) and high defect density (10^{16}/cm^3), a-Si devices can achieve J/sub sc/ ≅ 15 mA/cm^2, V/sub oc/ as high V and FF ≅ 0.72; and (b) novel a-Si devices have been designed and analyzed. The analysis shows that the flexibility in material properties offered by a-Si can be used advantageously to design high quality devices.

4170 (DOE/ET/23039—2) **Synthesis, evaluation, and defect compensation of tetrahedral glasses as possible solar cell materials. Quarterly technical progress report No. 2, May 1-July 31, 1979.** Rauh,

R.D. (EIC Corp., Newton, MA (USA)). Sep 1979. Contract AC03-79ET23039. 18p. Dep. NTIS, PC A02/MF A01.

Work performed on the project to synthesize A/sup II/B/sup IV/C_2/sup V/ glasses and evaluate their potential use as solar cell materials is described. The major effort was directed towards preparation of these films by thermal evaporation of compounds synthesized during the first quarter. Films were produced from $CdAs_2$, $CdSnAs_2$, $CdSiAs_2$, $ZnSiAs_2$ and $ZnAs_2$. Only films from the last compound had a stoichiometry comparable to the starting material. The ternary films were deficient in the group IV element and films produced from $CdAs_2$ indicated the sample had undergone extensive decomposition. In addition to having good stoichiometries, the x-ray analysis of the $ZnAs_2$ films indicated they were amorphous. The work thus represents the first reported results of preparation of amorphous films of $ZnAs_2$. The optical and electrical properties of this material will be characterized in the next quarter.

4171 (DOE/JPL/954328—12) **Measurement techniques and instruments suitable for life-prediction testing of photovoltaic arrays.** Noel, G.T.; Wood, V.E.; McGinniss, V.D.; Hassell, J.A.; Richard, N.A.; Gaines, G.B.; Carmichael, D.C. (Battelle Columbus Labs., OH (USA)). 31 Mar 1979. Contract NAS-7-100-954328. 79p. Dep. NTIS, PC A05/MF A01.

To aid in meeting the need for establishing reliable tests for characterizing the response with time of present and future encapsulated photovoltaic modules, a two-phase study was conducted to identify specific measurement requirements as well as applicable or potentially applicable measurement techniques for satisfying those requirements. Phase I of the study reviewed relevant degradation modes and mechanisms, including contributing environmental stresses, and identified and recommended all techniques and instruments judged suitable for characterizing specific types and classes of degradation modes. One category of techniques identified and recommended included techniques which required some further experimental evaluation and/or developmental work in order to establish their applicability and sensitivity precision. This category of recommendations formed the basis for the Phase II evaluations. In Phase II, three techniques requiring such experimental evaluation were selected from those recommended in the Phase I study for a preliminary experimental evaluation. The techniques were selected on the basis of their potential advantage in sensitivity or in on-site applicability. Specular and nonspecular optical reflectance measurements were chosen because of their potential for on-site use in studying delamination, and other interface flaws and degradation modes. Chemiluminescence measurements were chosen for evaluating UV-radiation-induced degradative changes in polymers because they offer a high degree of sensitivity and precision in characterizing such changes. Electrical noise measurements were chosen for evaluating cell series-resistance changes associated with contact corrosion and/or debonding because of the inadequacy of conventional techniques and their potential adaptability to on-site use.

4172 (DOE/JPL/954343—15) **Process feasibility study in support of silicon material. Task I. Quarterly technical progress report (XV), April-June 1979.** Li, K.; Hansen, K.C.; Yaws, C.L. (Lamar Univ., Beaumont, TX (USA). Dept. of Chemical Engineering). Jun 1979. Contract NAS-7-100-954343. 23p. Dep. NTIS, PC A02/MF A01.

Analyses of process system properties were continued for materials involved in the alternate processes under consideration for semiconductor silicon. Primary efforts centered on physical and thermodynamic property data for dichlorosilane. The following property data are reported for dichlorosilane which is involved in processing operations for solar cell grade silicon: critical temperature, critical pressure, critical volume, critical density, acentric factor, vapor pressure, heat of vaporization, gas heat capacity, liquid heat capacity and density. Work was initiated on the assembly of a system to prepare binary gas mixtures of known proportions and to measure the thermal conductivity of these mixtures between 30° and 350°C. The binary gas mixtures will include silicon source material such as silanes and halogenated silanes which are used in the production of semiconductor silicon. Chemical engineering analysis of the BCL process was continued with major efforts being concentrated to the preliminary process design. Primary activities in the preliminary design were devoted to determining production labor requirements for operating the major process equipment. The plant was divided into the following sections for determining labor: Purification (I), Deposition (II), Electrolysis (III), Waste Treatment (IV) and Product Handling (V). The results indicated the production labor requirements were 0.06309 man-hr/kg silicon production for the plant size of 1,000 metric tons/year.

4173 (DOE/JPL/954374—9) **Slicing of silicon into sheet material. Silicon sheet growth development for the large area silicon sheet task of the Low Cost Silicon Solar Array Project. Twelfth quarterly report, December 30, 1978-March 30, 1979.** Fleming, J.R. (Varian Associates, Lexington, MA (USA). Lexington Vacuum Div.). 1979. Contract NAS-7-100-954374. 22p. Dep. NTIS, PC A02/MF A01.

Testing of low-cost low-suspension power slurry vehicles is continuing. Results to date indicate that commercial cutting oils are unlikely to work, but a mineral oil with additives should be workable. Further testing to select the proper additives is necessary. Water based vehicle now appears possible, but again there are incidental problems and much testing may be required. Two different abrasives were tested. A cheaper silicon carbide from Norton gave excellent results except for excessive kerf loss: apparently the particles are too big. An abrasive treated for lubricity showed no lubricity improvement in mineral oil vehicle. The bounce fixture was tested for the first time under constant cut rate conditions (rather than constant force). Although the cut was not completed before the blades broke, the blade lifetime of thin (100 μm) blades was 120 times the lifetime without the fixture. The large prototype saw has completed a very successful run, producing 90% cutting yield (849 wafers) at 20 wafers/cm. Although inexperience with large numbers of wafers caused cleaning breakage to reduce this yield to 74%, the yield was high enough that the concept of the large saw is regarded to be workable. For the first time recycled abrasive was obtained from used slurry and will be tested shortly.

4174 (DOE/JPL/954605—5) **Development of low-cost, high energy-per-unit-area solar cell modules. Final report.** Jones, G.T.; Chitre, S.; Rhee, S.S. (Sensor Technology, Inc., Chatsworth, CA (USA)). Apr 1978. Contract NAS-7-100-954605. 151p. Dep. NTIS, PC A08/MF A01.

The development of two hexagonal solar cell process sequences, a laser-scribing process technique for scribing hexagonal and modified hexagonal solar cells, a large throughput diffusion process, and two surface macrostructure processes suitable for large scale production are described. Experimental analysis was made on automated spin-on antireflective coating equipment and high pressure wafer cleaning equipment. Six hexagonal solar cell modules were fabricated; they demonstrated that module efficiency can be significantly improved by the utilization of hexagonal or modified hexagonal solar cells replacing round cells due to increased solar cell packing ratio and increased solar cell photovoltaic energy conversion efficiency. A detailed theoretical analysis on the optimum silicon utilization by modified hexagonal solar cells for low-cost, high energy-per-unit-area solar cell modules is given. It is shown that an optimum modified hexagonal solar cell module will produce a cost savings compared to a round cell module. A cost analysis was performed using SAMICS on all process steps in this program. Two model companies were studied: CELLCO, a company that produces solar cells from silicon wafers, and MODULCO, a company that assembles solar cell modules from solar cells and encapsulant materials. The SAMICS method was applied to the hexagonal solar cell module using Sensor Technology's current proprietary process steps and three new process procedures: surface macrostructure, diffusion, and laserscribe. The conclusions show that the 1978 LSSA cost goal of $7/Wpk for solar cell modules is achievable. It is recommended, however, that significant development efforts be directed toward low-cost silicon wafer materials, low-cost encapsulant materials, and process automation.

4175 (DOE/JPL/954862—5) **Development of a model and computer code to describe solar grade silicon production processes. Fifth quarterly report.** Srivastava, R.; Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Feb 1979. Contract NAS-7-100-954862. 36p. (AeroChem-TN—202). Dep. NTIS, PC A03/MF A01.

This program aims at developing mathematical models, and computer codes based on these models, which will allow prediction of the product distribution in chemical reactors in which gaseous silicon compounds are converted to condensed-phase silicon. The reactors to be modeled are flow reactors in which silane or one of the halogenated silanes is thermally decomposed or reacted with an alkali metal, H_2 or H atoms. Because the product of interest is particulate silicon, processes which must be modeled, in addition to mixing and reaction of gas-phase reactants, include the nucleation and growth of condensed Si via coagulation, condensation, and heterogeneous reaction. During this report period computer codes were developed and used to calculate: (1) coefficients for Si vapor and Si particles describing transport due to concentration and temperature gradients (i.e., Fick and Soret diffusion, respectively), and (2) estimates of thermochemical properties of Si n-mers. The former are needed to allow the mass flux of Si to reactor walls to be calculated. Because of the extremely large temperature gradients that exist in some of the reactors to be used in producing Si (particularly the Westinghouse reactor), it was found that thermal (Soret) diffusion can be the dominant transport mechanism for certain sizes of Si particles. The thermochemical estimates are required to allow computation of the formation rate of Si droplets. With the completion of these calculations the information and coding of the particle routines in the modified LAPP code is at the point where debugging can be done and that is now in progress.

4176 (DOE/JPL/954862—6) **Development of a model and computer code to describe solar grade silicon production processes.** Srivastava, R.; Gould, R.K. (Aerochem Research Labs., Inc., Princeton,

NJ (USA)). May 1979. Contract NAS-7-100-954862. 34p. (AeroChem-TN—206). Dep. NTIS, PC A03/MF A01.

This program aims at developing mathematical models and computer codes based on these models, which allow prediction of the product distribution in chemical reactors for converting gaseous silicon compounds to condensed-phase silicon. The major interest is in collecting silicon as a liquid on the reactor walls and other collection surfaces. Two reactor systems are of major interest, the Westinghouse $SiCl_4$/Na reactor in which Si(l) is collected on the flow tube reactor walls and the new AeroChem reactor in which Si(l) droplets formed by the $SiCl_4$/Na reaction are collected by a jet impingement method. During this quarter the following tasks have been accomplished: (1) formulation of a model for silicon vapor separation/collection from the developing turbulent flow stream within reactors of the Westinghouse type, (2) modification of an available general parabolic code to achieve solutions to the governing partial differential equations (boundary layer type) which describe migration of the vapor to the reactor walls, (3) a parametric study using the boundary layer code to optimize the performance characteristics of the Westinghouse reactor, (4) calculations relating to the collection efficiency of the new AeroChem reactor, and (5) final testing of the modified LAPP code for use as a method of predicting Si(l) droplet sizes in the these reactors.

4177 (DOE/JPL/954886—5) **LSA large area silicon sheet task continuous liquid feed Czochralski growth. Quarterly report No. 5, October-December 1978.** Fiegl, G. (Siltec Corp., Menlo Park, CA (USA)). Jan 1979. Contract NAS-7-100-954886. 26p. Dep. NTIS, PC A03/MF A01.

Research on the design and development of equipment and processes, to demonstrate continuous growth of crystals by the Czochralsi method, suitable for producing single silicon crystals for use in solar cells is described. Continuous growth is defined as the growth of 100 Kg of single silicon crystal, 10 cm in diameter, from one container. Siltec's approach to meeting this goal is to develop a furnace with continuous liquid replenishment of the growth crucible, accomplished by a melt-down system and a liquid transfer mechanism, with associated automatic feedback controls. Elements of the transfer system were further developed and tested during actual transfer runs. Considerable simplification of the heating element of the transfer tube was achieved. Accuracy and reliability of the temperature sensor, which is part of the power input control system for the transfer tube, was improved. Following the schedule of the growth demonstration plan, melt-down and transfer of molten silicon from the melt-down crucible into the growth crucible containing molten silicon was performed successfully, verifying the melt-down and transfer operation (rate of silicon transfer > 2 Kg/hr). The final task of the growth demonstration plan prior to attempting 100 Kg throughput runs was achieved. This included the demonstration of continuous melt replenishment of the growth crucible while growing a crystal of 100 mm diameter and maintaining a constant melt level in the growth crucible. Crystals grown from a melt with continuous liquid replenishment exhibited a very small or zero longitudinal resistivity gradient when the ratio of the dopant concentrations of the replenishing melt to the melt in the growth crucible was equal to the effective segregation coefficient of the used dopant.

4178 (DOE/JPL/954887—5) **LSA large area silicon sheet task continuous Czochralski process development. Final report.** Rea, S.N. (Texas Instruments, Inc., Dallas (USA)). Feb 1979. Contract NAS-7-100-954887. 67p. Dep. NTIS, PC A04/MF A01.

A commercial Czochralski crystal growing furnace was converted to a continuous growth facility by installation of a small, in-situ premelter with attendant silicon storage and transport mechanisms. The premelter was situated immediately over the primary melt and provided a molten silicon flow into the large crucible simultaneously as crystal was being grown. The key element in this continuous Czochralski process is the premelter and a substantial portion of the program involved its evolution into a workable design. The best arrangement tested was a vertical, cylindrical graphite heater containing a small fused quartz test tube liner from which the molten silicon flowed out the bottom. Approximately 83 cm of nominal 5-cm diameter crystal was grown with continuous melt addition furnished by the test tube premelter. High-perfection crystal was not obtained, however, due primarily to particulate contamination of the melt. A major contributor to the particulate problem was severe silicon oxide buildup on the premelter which would ultimately drop into the primary melt. Elimination of this oxide buildup will require extensive study and experimentation and the ultimate success of continuous Czochralski depends on a successful solution to this problem. Economic modeling of the continuous Czochralski process utilized the IPEG option of SAMICS. The influence of both crystal size and total furnace run size were examined. Results of these studies indicate that for 10-cm diameter crystal, 100-kg furnace runs of four or five crystals each are near optimal. Costs tend to asymptote at the 100-kg level so little additional cost improvement occurs at larger runs. For these conditions, crystal cost in equivalent wafer area of around $\$16/m^2$ exclusive of polysilicon and slicing is obtained. Lower crystal costs can be obtained by growing larger diameter crystal in the 12 to 15-cm range.

4179 (DOE/JPL/955077—3-T1) **Evaluation of the technical feasibility and effective cost of various wafer thicknesses for the manufacture of solar cells. Second quarterly progress report, September 30, 1978-January 15, 1979.** (Solarex Corp., Rockville, MD (USA)). 1979. Contract NAS-7-100-955077. 55p. Dep. NTIS, PC A04/MF A01.

Fourteen wafering characterization runs have been completed on the Yasunaga wire saw. Wafer thickness/taper uniformity is excellent. Several alterations and design adjustments have been made, facilitating saw operation. A wafering characterization cycle has been initiated, and is close to completion. A cell characterization cycle has been initiated. Panel design, construction and evaluation will begin during the next quarter.

4180 (DOE/JPL/955217—4) **Development of high efficiency (14%) solar cell array module. First quarterly report, November 29, 1978-March 15, 1979.** Iles, P.A.; Khemthong, S.; Olah, S.; Sampson, W.J.; Ling, K.S. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1979. Contract NAS-7-100-955217. 28p. Dep. NTIS, PC A03/MF A01.

The development of the high efficiency, P/N silicon solar cells has begun. The best efficiency achieved to date on the 3" diameter cell was 15.6% at AM1 and 28°C, slightly below that of 16.5% required for the fabrication of 14% efficiency module. Work is continuing on the cell development, with efforts concentrating on junction formation and back surface field application. The design of the module was completed utilizing 120 3" diameter cells, Sunadex glass as the superstrate, polyvinyl butyral as the encapsulant, extruded aluminum channel for framing, and Teflon insulated flexible leads as the electrical terminals. The design of the production tooling has been submitted for design review. The tooling consists of: (1) back contact soldering machine, (2) vacuum pickup, (3) anti-reflective coating tooling, and (4) test fixture.

4181 (DOE/JPL/955278—1) **Automated solar panel assembly line. LSA task: production processes and equipment. Quarterly report No. 1.** Somberg, H. (ARCO Solar, Inc., Chatsworth, CA (USA)). 8 Apr 1979. Contract NAS-7-100-955278. 17p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to design, fabricate and demonstrate an automated solar cell module production line with the ultimate goal of reducing module assembly costs. During this reporting period the automated module design was completed. The design of the solar cell assembly prototype (SCAP) was about 75% completed and the solar panel lamination prototype (SPLP) was built and tested.

4182 (DOE/JPL/955281—05) **Use of glass reinforced concrete (GRC) as a substrate for photovoltaic modules. Quarterly report No. 1.** (MB Associates, San Ramon, CA (USA)). 5 Apr 1979. Contract NAS-7-100-955281. 16p. Dep. NTIS, PC A02/MF A01.

MBAssociates, with the assistance of Concrete Consulting Corporation, contracted to investigate, design, develop, and deliver to JPL for testing, Low-Cost Flat Plate Photovoltaic Solar Panels using fiberglass reinforced concrete (GRC) as substrate and panel structures. The first quarter results indicate that the ultimate goals can be reached, which are, to design and produce a panel that will withstand a wind load resistance of +- 50 psf, be four-point supported, suited to automated production, have a life expectancy of 20 years and have a material cost of less than $0.39 psf (1975 dollars). The approach used, the type of data collected, the criteria considered and the preliminary designs chosen are described.

4183 (DOE/JPL/955307—1) **Analysis of the effects of impurities in silicon. First quarterly report, January 19-April 30, 1979.** Wohlgemuth, J.H. (Solarex Corp., Rockville, MD (USA)). 1979. Contract NAS-7-100-955307. 35p. Dep. NTIS, PC A03/MF A01.

The purpose of this program is to conduct a solar cell fabrication and analysis program to determine the effects on the resultant solar cell efficiency of impurities intentionally incorporated into silicon. The program will employ flight-quality technologies and quality assurance to assure that variations in cell performance are due to the impurities incorporated in the silicon. The initial program quarter was dedicated to (1) preparation of the detailed Program Plan including a detailed Quality Assurance Plan, (2) the identification and ordering of the processing equipment and materials required for handling of impure wafers, (3) the training of processing personnel to familiarize them with the process sequence and Q.A. requirements, (4) the set-up and check out of all process equipment and process parameters, (5) the development of various control log books and data sheets, and (6) processing of verification cells to serve as a data base for all experimental work. The initial verification runs have resulted in an average AMO cell efficiency of 12.8% at 25°C (In excess of 15% AM1 at 25°C). Test runs will begin

upon completion of six verification runs and JPL approval of the program plan.

4184 (DOE/JPL/955318—1) **New method of metallization for silicon solar cells. First quarterly report, December 15, 1978-March 31, 1979.** Macha, M. (SOL/LOS, Inc., Los Angeles, CA (USA)). 1979. Contract NAS-7-100-955318. 21p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to develop a low-cost ohmic contact on silicon solar cells based on molybdenum tin metal system. The approach is based on the formulation of a screenable ink composed from molybdenum oxide and tin mixture. The first quarter of this program involved the study of the reduction of MoO_3 into Mo and the establishing of MoO_3:Sn ratio. Both tasks have been done in an experimental station constructed for this purpose. The results showed that molybdenum was formed from its oxide at 800°C and improved in bonding to silicon at 900°C. A 20% MoO_3-80% Sn mixture was converted into a metallic coating within this temperature range. The next quarter will be concerned with the formulation of screenable ink, calibration of a tube furnace for the firing cycle and evaluation of the metal contact on solar cell structures.

4185 (DOE/JPL/955328—1) **Establishment of a production-ready manufacturing process utilizing thin silicon substrates for solar cells. Quarterly technical report No. 1, February 1-March 31, 1979.** Pryor, R.A. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-955328. 18p. Dep. NTIS, PC A02/MF A01.

Status of the research on the investigation, development, and characterization of methods for establishing a production-ready manufacturing process which utilizes thin silicon substrates for solar cells is described. These thin substrates will be 3 inch diameter, p-type Czochralski wafers of approximately 1 Ω cm resistivity. These wafers are being purchased from the Motorola Semiconductor Group Materials Operation and will be prepared by sawing directly to thicknesses of 8 mils and 5 mils. To ensure removal of residual saw damage, most substrates will be chemically etched to final thicknesses of 7 mils and 4 mils. Some substrates will be received as-sawed in order to evaluate the optimum thickness of saw damage removal. The thin substrates will be used to fabricate solar cells by standard processing techniques.

4186 (DOE/NASA/20485—79/5) **Evaluation of cleaners for photovoltaic modules exposed in an outdoor environment.** Knapp, W.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1979. Contract EX-76-A-29-1022. 18 p. (NASA-TM—79248). Dep. NTIS, PC A02/MF A01.

Power recovery of silicone encapsulated and glass-covered photovoltaic modules, exposed for 2 years to a suburban environment, was measured after washing with a variety of cleaners including detergents, abrasive soap, and hydrocarbon solvents. Silicone encapsulated modules in operating environments may experience significant power losses or require extensive periodic cleaning. Glass front-faced modules in similar situations are much less affected. Organic hydrocarbon solvents or abrasives were found to be about five times more effective than mild detergents in cleaning silicone encapsulated modules.

4187 (DSE—4042-T6) **Cadmium sulfide/copper ternary heterojunction cell research. First quarterly technical progress report, February 26-May 31, 1979.** Mickelsen, R.A.; Chen, W.S.; Wei, P.S.P. (Boeing Aerospace Co., Seattle, WA (USA)). Jun 1979. Contract EG-77-C-01-4042. 25p. Dep. NTIS, PC A02/MF A01.

A description is given on the preparation of $CuInSe_2$ thin films by simultaneous elemental evaporation onto heated alumina substrates using Electron Impact Emission Spectroscopy (EIES) to control Cu and In vaporization rates. The formation of single phase, chalcopyrite structure, P-type $CuInSe_2$ film material with a polycrystalline grain size slightly under one micron is reported. The preparation, application, and properties of In deficient selenide films is discussed. RF sputtered Mo films are described as an acceptable low-cost metallization approach for CdS/$CuInSe_2$ thin film cells. Finally, the results of retesting of Boeing's highest efficiency CdS/$CuInSe_2$ thin film cell after eight months storage are reported which indicate excellent cell stability.

4188 (SERI/TP—49-186, pp 117-119) **Export potential for photovoltaic systems.** Campbell, R.S. (Battelle-Pacific Northwest Labs., Richland, WA). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The export market for photovoltaic power systems offers a challenging and historically significant opportunity for American technology. The size of the opportunity and the challenges and problems associated with attempting to capitalize upon it are briefly described. Six major areas are cited, but all are not discussed here. These are characteristics of technology and market; market size estimation (demographic need, qualitative, and quantitative); market share estimation; competitive assessment and dynamics; and policy considerations. It is concluded, though, that photovoltaics represents a very large potential market that has attracted some strong initial contenders. How well the US will succeed in capturing significant share of that market depends on how aggressively it seeks it in terms of price, technology, and marketing. (MCW)

4189 **Contact for solar cells.** Pryor, R.A. (to Motorola, Inc.). US Patent 4,171,989. 23 Oct 1979. Filed date 2 Feb 1978. 8p.

An improved solar energy device has a body of semiconductor material of a first conductivity type with a region of a second conductivity type formed in the body and extending to its surface. A current collection metallization pattern is disposed on the second conductivity type region, with at least three distinct and identifiable current accumulation points connected to the metallization pattern adjacent to the periphery of the second conductivity type region. External electrical connection is made to extract available electrical power from the device at the current accumulation points. The periphery of the device is free of other electrically equivalent external electrical connection areas. These features allow a substantial increase in device efficiency. 7 claims.

4190 **Solar energy to electrical energy converter.** Forrat, F. (to Commissariat a l'Energie Atomique). US Patent 4,171,003. 16 Oct 1979. Priority date 5 Apr 1977, France, 8p.

Solar radiation is collected and directed through transparent material for the optical conversion of solar radiation to infrared radiation onto a rod-shaped multijunction semi-conductor photovoltaic cell. This is achieved by means of a focusing structure of linear form having a focal line and a plate of transparent converting material. The plate is placed in the vicinity of the focal line and performs the double function of light guide and optical converter. The semiconductor rod is placed along one of the longitudinal edges of the plate. 4 claims.

4191 **Method for encapsulating a solar cell array.** Keeling, M.C.; Doss, D.E. (to Motorola, Inc.). US Patent 4,170,507. 9 Oct 1979. Filed date 27 Dec 1977. 6p.

An enclosure for a solar cell array and a method of fabricating a solar cell module are disclosed. The array is enclosed between a metal back plate and a cover glass. The edges of the enclosure are sealed by a pliable sealant material and a spring loaded bezel that is riveted or welded in place. The interior of the enclosure is filled with a potting material which surrounds and cushions the solar cell array. During the module fabrication a fixture supports the enclosure parts and provides a temporary edge seal to facilitate the potting procedure. Controlled flexure of the enclosure back plate and controlled spacing of the cover glass ensure a compressive loading of the potting material which eliminates possible delamination of the potting material in its subsequent usage.

4192 **Double-sided solar cell with self-refrigerating concentrator.** Luque, A. US Patent 4,169,738. 2 Oct 1979. Priority date 24 Nov 1976, Spain, 8p.

A planar solar cell photovoltaically active on both sides is positioned in a solar concentrator capable of simultaneously illuminating both sides of the cell. The cell is immersed in a transparent liquid that enhances solar energy concentration and aids in removing undesirable heat from the cell. The solar cell, having two photovoltaically active sides, can be constituted by a n+pn+ structure or by a n+pn+ structure. Electrically conductive metal grids serving as cathode and anode connections are formed on both sides of the cell. The grid apertures advantageously allow the light to enter into the appropriate semiconductor regions. In the case of a n+pn+ structure, window means in the n+ layers are provided to permit electrical contact between the anode grids and the p region. Solar cells with complementary dopings, for example p+np+, are also possible. 5 claims.

4193 **Cuprous sulfide layer formation for photovoltaic cell.** Castel, E.D. (to Photon Power, Inc.). US Patent 4,167,805. 18 Sep 1979. Filed date 17 Jul 1978. 6p.

An improved method for fabrication of a photovoltaic cell preferably of the CdS--Cu/sub x/S type, having a copper electrode adjacent the Cu/sub x/S, is described. A portion of the CdS is converted to Cu/sub x/S through ion exchange wherein the CdS is immersed in a first solution of cuprous ions and a second solution of cupric ions to produce a non-stoichiometric Cu/sub x/S. A layer of metallic copper is applied by conventional techniques, such as vacuum deposition, and the photovoltaic cell heat treated to affect formation of the CdS--Cu/sub x/S heterojunction. Metallic copper diffusing through the CdS and Cu/sub x/S from the electrode is captured by the non-stoichiometric Cu/sub x/S whereby the Cu/sub x/S is substantially stoichiometric in the completed photovoltaic cell. 12 claims.

4194 **Solar cell module.** Kurth, W.T.; Miles, S.G. (to Exxon Research and Engineering Co.). US Patent 4,167,644. 11 Sep 1979. Filed date 29 Sep 1978. 6p.

A solar cell module consisting of a solar cell panel and a frame therefor is disclosed. The solar cell panel is formed from a hard, light transparent sheet material which preferably is glass and has arrayed on the bottom surface of the glass a plurality of individual solar cells interconnected in the requisite series and/or parallel circuit arrangement. The cells are bonded permanently to the underside of the panel by suitable bonding means such as a silicon adhesive. The rear surface of the solar cells and glass is covered with a suitable material, preferably with a light transparent elastomer, to protect the cells from the elements, thereby preventing corrosion of the electrical contacts. The frame extends around the perimeter of the solar panel and has at least one top flange that is essentially coplanar with the solar panel for supporting engagement with a setting strip of resilient material. The setting strip has parts embracing the flange and the marginal edge of the solar cell panel. 12 claims.

4195 Method of removing the effects of electrical shorts and shunts created during the fabrication process of a solar cell. Nostrand, G.E.; Hanak, J.J. (to RCA Corporation). US Patent 4,166,918. 4 Sep 1979. Filed date 19 Jul 1978. 4p.

A method of removing the effects of electrical shorts and shunts created during the fabrication process and improving the performance of a solar cell with a thick film cermet electrode opposite to the incident surface by applying a reverse bias voltage of sufficient magnitude to burn out the electrical shorts and shunts but less than the break down voltage of the solar cell is described. 10 claims.

4196 Cermet layer for amorphous silicon solar cells. Hanak, J.J. (to RCA Corporation). US Patent 4,167,015. 4 Sep 1979. Filed date 24 Apr 1978. 6p.

A transparent high work function metal cermet forms a Schottky barrier in a Schottky barrier amorphous silicon solar cell and adheres well to the P+ layer in a PIN amorphous silicon solar cell. 16 claims.

4197 Amorphous silicon solar cell allowing infrared transmission. Carlson, D.E. (to RCA Corporation). US Patent 4,166,919. 4 Sep 1979. Filed date 25 Sep 1978. 6p.

An amorphous silicon solar cell is described with a layer of high index of refraction material or a series of layers having high and low indices of refraction material deposited upon a transparent substrate to reflect light of energies greater than the bandgap energy of the amorphous silicon back into the solar cell and transmit solar radiation having an energy less than the bandgap energy of the amorphous silicon. 14 claims.

4198 Device for the synchronized unfolding of articulated elements carrying solar cells in a panel formed by a series of articulated elements. Marello, G.; Vermalle, J.C. (to Societe Nationale Industrielle Aerospatiale). US Patent 4,155,524. 22 May 1979. Priority date 17 Nov 1976, France, 8p.

Synchronized angular displacement of articulated elements of an outwardly-extendable solar-cell panel is carried out by means of a device mounted between any two successive panel elements constituting a driving element and a driven element. Two independent and parallel traction members are pivotally mounted on support plates which are rigidly fixed to two successive driving elements. Two link-arms for traction members such as cables are pivotally attached to pins forming anchoring points for the cables. Each support plate has two stationary stops for limiting the angular displacements of the link-arms during the relative pivotal movement of the driven element with respect to the driving element. 6 claims.

4199 Continuous process for fabricating solar cells and the product produced thereby. Deminet, C.; Horne, W.E.; Oettel, R.E. (to The Boeing Company). US Patent 4,152,535. 1 May 1979. Filed date 6 Jul 1976. 12p.

The process comprises the following steps: (1) forming a glass sheet which defines a substrate layer for the solar cell product; (2) forming a diffusion barrier layer on at least one surface of the substrate; (3) forming a first electrically-conductive layer on the diffusion barrier, the first electrically-conductive layer being a first electrode in the solar cell product; (4) depositing small-grain polycrystalline silicon in a thin film, i.e., 10 to 100 micrometers, on the first electrode layer; (5) recrystallizing, typically by heating, the deposited polycrystalline silicon until it reforms into large-grain polycrystalline or single-crystal silicon; (6) forming a PN junction in the recrystallized silicon layer; and (7) forming a second electrically-conductive layer on the recrystallized silicon layer, the second electrically-conductive layer being a second electrode in the solar cell product. The solar cell product produced by the above-process may be fabricated in large surface area configurations, suitable for terrestrial as well as extra-terrestrial use, at relatively low cost. 13 claims.

4200 Silicon solar cell assembly. Burgess, E.L.; Nasby, R.D.; Schueler, D.G. (to Department of Energy). US Patent 4,152,175. 1 May 1979. Filed date 24 Jul 1978. 4p.

PAT-APPL-927,236.

A silicon solar cell assembly comprising a large, thin silicon solar cell bonded to a metal mount for use when there exists a mismatch in the thermal expansivities of the device and the mount is described. 6 claims.

4201 Method for forming p-n junctions and solar-cells by laser-beam processing. Narayan, J.; Young, R.T. (to Department of Energy). US Patent 4,147,563. 3 Apr 1979. Filed date 9 Aug 1978. 8p.

PAT-APPL-932,154.

This invention is an improved method for preparing p-n junction devices, such as diodes and solar cells. High-quality junctions are prepared by effecting laser-diffusion of a selected dopant into silicon by means of laser pulses having a wavelength of from about 0.3 to 1.1 μm, an energy area density of from about 1.0 to 2.0 J/cm^2, and a duration of from about 20 to 60 nanoseconds. Initially, the dopant is deposited on the silicon as a superficial layer, preferably one having a thickness in the range of from about 50 to 100 A. Depending on the application, the values for the above-mentioned pulse parameters are selected to produce melting of the silicon to depths in the range from about 1000 A to 1 μm. The invention has been used to produce solar cells having a one-sun conversion efficiency of 10.6%, these cells having no antireflective coating or back-surface fields. 9 claims.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 4476, 4942

4202 (BMI—2031(Vol.1)) **Carbohydrate crops as a renewable resource for fuels production. Volume I. Agricultural research.** Lipinsky, E.S.; Jackson, D.R.; Kresovich, S.; Arthur, M.F.; Lawhon, W.T. (Battelle Columbus Labs., OH (USA)). 15 May 1979. Contract W-7405-ENG-92. 94p. Dep. NTIS, PC A05/MF A01.

Narrow-row spacing of sweet sorghum and sugarcane as a means of reducing costs and increasing availability in selected geographical areas was emphasized. More specifically, the influence of row spacing, cultivar selection, and planting date on yield and composition of sweet sorghum were evaluated in a typical corn belt state (Ohio). Similar data were obtained for Texas, Louisiana, Mississippi, and Florida for sweet sorghum and sugarcane. (MHR)

4203 (COO—4709-T1) **Nutrient content of certain crop residues and possible losses with removal. Appendices A-H.** Clambey, G. (North Dakota State Univ., Fargo (USA). Dept. of Botany). Dec 1978. Contract ET-78-G-02-4709. 143p. Dep. NTIS, PC A07/MF A01.

The following are included: nutrient content of certain crop residues and possible losses with removal, biomass distribution and availability, biomass equipment survey and evaluation, condition of present municipal power plant, fluidized bed burners, heat balances, selection of best alternate solution for burning biomass, summary and conclusions of potential for oil sunflower production and processing in North Dakota, and a proposed amendment to a DOE grant. (MHR)

4204 (DSE—3077-T1) **Investigation of woody biomass species for fuel production in warm climate, non-agricultural land irrigated by brackish or saline water. Final report, April 24, 1978-April 24, 1979.** Garrett, D.E. (Garrett Energy Research and Engineering Co., Inc., Ojai, CA (USA)). 24 Apr 1979. Contract ET-78-C-01-3077. 209p. Dep. NTIS, PC A10/MF A01.

Over 17,000 Tamarisk plants were grown in an approximately 1.5 acre plot of very poor soil in the central San Joaquin Valley at Hanford, California. Tamarix aphylla (Athel Tree) cuttings were tested in a variable fertilization and water salinity statistically designed standard agronomic program. Other variables were studied with potted T. aphylla, T. pentandra (Salt Cedar), T. hispida and T. africana on a semi-quantitative basis. The T. aphylla cuttings produced more growth (weight) than the other species, although the increase in height was about the same for all species. Growth varied considerably among the sub-plots because of a spotty hardpan and very high zinc levels. The plants averaged about 0.4 inches of growth per day from planting in May until growth stopped in November, and produced a dry weight yield for this short season of about 7.4 dry tons/acre/year, assuming an 18 inch spacing. The average yield for the better plots was 14 DTE/acre/yr., and old trees at Boron, California, averaged 13 DTE/acre/yr. Nitrogen fertilizer increased growth by about 38% at a level of 300 Kg/ha. Water containing 600 to 35,000 ppM salts did not change the growth rate appreciably.

4205 (ORO—5373-T1) **Potential of producing and harvesting sugarcane and sweet sorghum as a renewable biomass energy resource.**

Annual report. Cochran, B.J.; Ricaud, R. (Louisiana State Univ. and Agricultural and Mechanical Coll., Baton Rouge (USA)). 31 Jul 1979. Contract EG-77-G-05-5373. 64p. Dep. NTIS, PC A04/MF A01.

Manufacturers of land clearing equipment, land leveling, ditching machinery, mold board plows, and lister plows are listed. A combined list of manufacturers of sugar cane tillage equipment is presented. Lists of manufacturers are included for the following types of equipment: planting, irrigation, spraying equipment, aerial application spraying and dusting equipment, power units, harvesting, loaders, and transport units. Methods of mechanical harvesting sugarcane and sweet sorghum grown from improved planting and production treatments are evaluated. Commercial mechanical systems available for harvesting maximum sugarcane biomass in the sugar production areas of the United States. (MHR)

4206 (SERI/TR—62-264) **Environmental and institutional considerations in the development and implementation of biomass energy technologies.** Schwab, C. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1979. Contract EG-77-C-01-4042. 46p. Dep. NTIS, PC A03/MF A01.

The photosynthetic energy stored in plant and organic waste materials in the United States amounts to approximately 40% of the nation's total energy consumption. Conversion of this energy to usable power sources is a complex process, involving many possible materials, conversion technologies, and energy products. Near-term biomass technologies are predominantly based on traditional fuel use and have the advantage over other solar technologies of fitting into existing tax and business practices. However, no other solar technology has the potential for such large environmental impacts. Unlike the conversion of sun, wind, and ocean thermal energy, the conversion of the biomass energy source, in the form of biomass residues and wastes, can create problems. Environmental impacts may be significant, and legal responses to these impacts are a key determinant to the widespread adoption of biomass technologies. This paper focuses on the major legal areas which will impact on biomass energy conversion. These include (1) the effect of existing state and federal legislation, (2) the role of regulatory agencies in the development of biomass energy, (3) governmental incentives to biomass development, and (4) legal issues surrounding the functioning of the technologies themselves. Emphasis is placed on the near-term technologies whose environmental impacts and institutional limitations are more readily identified. If biomass energy is to begin to achieve its apparently great potential, these questions must receive immediate attention.

4207 (SHS-IFST-RU—85-1975) **Firing equipment for wood residues.** (Skogshoegskolan, Garpenberg (Sweden). Institutionen foer Skogsteknik). 1975. 76p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

The combustion technology for firing with wood and wood residues in different types of boilers and pyrolysis of wood is described. For burning wood residues or wood in Sweden, boilers are considered most suitable. Procedures for treatment, transport, and storage of the fuel are also summarized. Different construction details such as the furnaces are discussed. Finally, a list of Swedish supplies of equipment is given.

4208 **Farming: the energy resource.** Cervinka, V.; Mason, D. Sacramento, CA; California Department of Food and Agriculture (Aug 1979). 20p. (NP—24020; LRP—16).

Rapidly increasing oil prices, energy dependence upon foreign countries, and high productivity of American farms have brought into question the efficiency of trading food for petroleum fuels on the international market. Decreased efficiency, measured in oil barrels per crop-hectare (acre) equivalent, is a reflection of increasing trend disparity between the prices of petroleum and farm commodities. As an alternative to dedicating agricultural resources to the production of farm-export commodities in order to finance oil imports, the direct route of producing energy crops for fuel is considered. Opportunities for such a policy change will exist where low-value export crops are currently being used to pay for oil imports, and when high-net-energy-yield crops and conversion practices are employed. These factors must exist in combination with the utilization of conversion by-products as high-quality food or feed commodities, industrial feedstocks, or soil amendments. In such a situation, and under rising oil prices, it will be more efficient to directly produce biofuel from crops rather than using comparable resources to produce farm export commodities in order to finance fossil-fuel imports.

4209 **Botanochemicals and chemurgy in the petroleum drought ahead.** Bagby, M.O.; Buchanan, R.A.; Duke, J.A. Peoria, IL; Department of Agriculture (1979). 28p. (CONF-791062—1). Dept. of Agriculture, Peoria, IL 61604.

From American Association of Cereal Chemists meeting; Washington, DC, USA (28 Oct 1979).

Green plants, collectively, are still a major under-exploited resource. However, new crops and agricultural systems are being developed for the production of fuels and materials in addition to foods and fibers. Whole-plant oils and botanochemicals are being evaluated as annually renewable replacements for petroleum crude and petrochemicals, respectively. Plant derived fuel alcohols are becoming a viable supplement to gasoline and fuel oils. Polyisoprenes, terpenes, oils, waxes, alcohols, phenols, furfural, methane, and producer gas from plant sources can potentially displace petroleum derived feedstocks for the synthetic chemical industry. Moreover, new botanochemical processing methods offer prospects for reducing US dependence on imports for many specialty plant-products traditionally produced by labor-intensive methods. Extraction of essential oils, pharmaceutical intermediates, tannins, and vegetable dyes may be integrated with botanochemical processing to allow exploitation of the varied US climate for domestic production of nearly every botanical now imported.

4210 **Integrated biological and agricultural systems.** Coombs, J. (Tate and Lyle Ltd., Reading, England). pp 74-78 of SOLTECH '78 conference proceedings. London, England; US-ISES (1978).

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

Methods for and difficulties with the production of fuels from biomass in the Middle East are reviewed. (MHR)

4211 **Chain of energy: sun → plant → animal → human being and its relationship to the lattice concept of plant production.** Ruthner, O. pp 79-83 of SOLTECH '78 conference proceedings. London, England; US-ISES (1978).

From Middle East solar technology exhibition and conference; Bahrain, Bahrain (24 Apr 1978).

The concept of industrial light-controlled plantations in greenhouses using the Ruthner lattice or three-dimensional concept of cultivation is reviewed. (MHR)

PHOTOVOLTAIC POWER PLANTS

4212 (COO—4094-62) **Battery charge/solar array controller for a residential size photovoltaic power system.** Cadieux, R.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Oct 1979. Contract EY-76-C-02-4094. 20p. Dep. NTIS, PC 02/MF A01.

A controller has been designed to meet the initial requirements of an off-peak, utility-interactive solar photovoltaic power system now undergoing tests at MIT Lincoln Laboratory's Photovoltaic System Test Facility in Concord, Massachusetts. A physical description of the controller, an explanation of the control algorithm, a circuit description and the theory of operation are presented.

4213 (DOE/ET/23057—1(Vol.2)) **Photovoltaic flat panel system for process power in battery manufacture. Volume 2. Final report, September 30, 1978-March 31, 1979.** (Gilbert/Commonwealth, Reading, PA (USA)). 1979. Contract ET-78-C-04-5397. 18p. Dep. NTIS, PC A02/MF A01.

Thirteen engineering drawings are presented for the 200 kw system. Drawings are included for the electrical conduit system (battery building, main building, and underground duct), electrical switchgear and main disconnect panel, electrical grounding and lightning protection system, layout and general arrangement, roof arrangement, mechanical HVAC system for battery building, electrical main system, and support structure. An electrical materials list is included. (WHK)

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 4314

4214 (SERI/TP—49-186, pp 147-154) **The Thermo Electron Experience.** Keiser, J.T. (Thermo Electron Corp., Waltham, MA). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The Thermo Electron Corporation manufactures industrial furnaces, and has subsidiaries involved in heat treating, papermaking equipment, environmental and health monitors, and cogeneration power systems. These businesses are located throughout the US and also in Canada, England, Mexico, Brazil, and Saudi Arabia. After evaluating the corporation's experience in international business, their rapid growth, and their commitment to energy conservation technologies, it was decided that they would pursue the manufacture of remote-location solar systems. These units can be used to generate power, cool, light, irrigate, or perform numerous other tasks.

4215 **Solar thermal electric systems.** Sakamoto, T.; Anzai, S.; Kobayashi, N. (to Agency of Industrial Science and Technology).

US Patent 4,171,617. 23 Oct 1979. Priority date 9 Nov 1976, Japan, 10p.

A solar thermal electric power system, in which a solar collector, a heat storage vessel filled with a thermal storage material adapted to effect a phase change between solid and liquid internally, a turbine, a condenser, a condensate storage tank, and a feed water pump is connected in a closed loop by suitable conduits. A first control valve is provided en route between the solar collector and a heat storage vessel. A steam accumulator filled with water is connected via a second control valve in a pipe route between the solar collector and the first control valve, as well as to a pipe route between the first control valve and the heat storage vessel via a third control valve. The temperature of a fluid flowing out of the solar collector is detected, and when the temperature detected is to be lower than a set temperature, then the first control valve is controlled so as to be closed, while the second control valve is opened. 8 claims.

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 4399

4216 (CONF-780983—, pp 125-126) **Development of a focusing solar collector energy conversion system.** Borton, D.; Rogers, W. (Rensselaer Polytechnic Inst., Troy, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Development of a modular concentrating solar collector package consisting of a glass mirror concentrator, a cavity boiler/receiver, structure, pump and programmable automatic controls is the focus of our work. The desired output is 250°C process steam made available by the above machine at a competitive price.

4217 (INKA-Conf—79-102-001) **Design of receivers fo solar tower plants.** Bammert, K. (Hannover Univ. (Germany, F.R.)). 1979. 25p. (CONF-7905118—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Seminar on steam and gas turbines II: solar systems with gas turbines; Karlsruhe, F.R. Germany (22 May 1979).

The design of a receiver for a closed-cycle gas turbine with air and helium as the working media is discussed. The emphasis of the investigations is layed upon the optimization of heat transfer to the working medium. The irradiation pattern along the tubes and the effects of the working medium pressure, the pressure loss and the tube cage geometry are considered.

4218 (MTR—7861) **Solar thermal repowering.** Curto, P.A.; Nikodem, Z.D. (Mitre Corp., McLean, VA (USA). METREK Div.). May 1978. Contract ET-78-C-01-2854. 73p. Dep. NTIS, PC A04/MF A01.

A program requirements analysis and a utility survey have been conducted by Metrek to establish the feasibility of a government commitment to solar thermal repowering. Repowering involves the retrofit of existing oil- and gas-fired steam plants in the southwestern US with the solar thermal central receiver (power tower) system. This report documents the probable plant configurations, market splits by plant type, state and fuel type; geographic distribution of sites; generic development plans for the construction of the system; development of manufacturing and support facilities; capital requirements; cost estimates; labor and material requirements; net energy analysis; utility reactions to the concept; and energy production implications. One requirements scenario is analyzed to determine the actions necessary to meet a goal of 0.1 quads per year of capacity by 1985. In addition, the SPURR model was used to simulate the effects of two proposed incentives programs to estimate probable market penetration, and results of this analysis are presented and compared to a National Energy Plan scenario.

4219 (MTR—7919) **Solar thermal repowering: utility/industry market potential in the Southwest.** Lord, N.; Curto, P.; True, S. (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1978. Contract ET-78-C-01-2854. 177p. Dep. NTIS, PC A09/MF A01.

This document provides an analysis of the utility and industrial solar thermal repowering market potential in the Southwest. Repowering involves adding the solar thermal central receiver (power tower) system as a retrofit power source for existing utilities and industries. It would provide steam to drive a utility turbogenerator or supply process heat for industry. This study analyzed the potential for repowering oil- and gas-using steam turbine utility sites with a capacity greater than 25 MWe and sufficient land adjacent to the plant for a minimum 25 MWe addition. Industry projections were based on an analysis of the energy requirements for the chemicals and petroleum industries in Texas and estimates of land availability. It is estimated that the potential solar thermal repowering market for utilities and industries in the Southwest is approximately one quad.

4220 (SAND—77-1173(Rev.)) **Central Receiver Test Facility (CRTF) experiment manual.** Holmes, J.T.; Matthews, L.K.; Seamons, L.O.; Davis, D.B.; King, D.L. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 81p. Dep. NTIS, PC A05/MF A01.

The Central Receiver Test Facility is operated by Sandia Laboratories for the US Department of Energy. The CRTF is being used for component and subsystem evaluation within the Solar Thermal Large Power Systems Program. This experiment manual provides users of the CRTF detailed information about: (1) implementation of testing at the CRTF; (2) details of the CRTF capabilities and interfaces, and (3) requirements of experimenters.

4221 (SAND—79-8777) **Solar Central Receiver Systems Program.** Fish, J.D. (Sandia Labs., Livermore, CA (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-791024—5). Dep. NTIS, PC A02/MF A01.

From Solar industrial process heat conference; San Francisco, CA, USA (31 Oct 1979).

Major elements of the DOE Solar Central Receiver Systems Program include development of storage-coupled and hybrid system concepts; the Central Receiver Test Facility in Albuquerque, NM; the pilot plant under construction at Barstow, CA; proposed repowering/industrial retrofit plants; and heliostat, receiver, and storage subsystems development work. Current and proposed activities within each element are discussed.

DISTRIBUTED COLLECTOR

4222 **Solar energy conversion unit.** Legg, H.W. US Patent 4,159,712. 3 Jul 1979. Filed date 20 Oct 1977. 10p.

A solar energy conversion unit is described having a collector forming a focal area in which is disposed a core assembly including a governor arranged for varying the surface area of fluid carrying tubes partly forming the core assembly that is exposed to solar radiation so as to maintain a desired fluid pressure within the conversion unit. At such time as the solar radiation impinging the collector becomes substantially less than that necessary to maintain suitable pressure in the fluid system of the unit, an auxiliary heater provided as part of the core assembly can be employed to supplement or replace the solar radiation. 12 claims.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 4218, 4219

OCEAN THERMAL GRADIENT POWER PLANTS

4223 (ANL/OTEC-PS—4) **OTEC performance tests of the Carnegie-Mellon University vertical fluted-tube condenser.** Lewis, L.G.; Sather, N.F. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 45p. Dep. NTIS, PC A03/MF A01.

Results of performance tests on a vertical fluted-tube condenser designed by Carnegie-Mellon University are reported. The condenser was free of operational problems and performed in a stable and repeatable manner. At nominal design conditions (a heat duty of 3.2 million Btu/hr and a water flow rate of 3200 gpm), the overall heat transfer coefficient (U_0) was 1040 Btu/hr.ft^2.°F and the water-side pressure drop was 3.3 psi. Varying the quality of the ammonia vapor feed to the condenser (in the range of 90 to 100%) did not affect performance. On the other hand, when the heat duty was increased from 2.3 million to 4.0 million Btu/hr, U_0 rose from 1024 to 105 Btu/hr.ft^2.°F. This trend resulted from an increase in the ammonia-side coefficient (from 3270 to 3730 Btu/hr.ft^2.°F) over this range of heat duties. Finally, the water-side coefficient was about 2.45 times greater than that calculated from the Sieder-Tate equation for smooth circular tubes of the same cross-sectional area. This enhancement ratio of 2.45 was some 20% greater than the enhancement factor of 2.07 expected from the increase in surface area alone.

4224 (DOE/ET/20445—2) **Engineering and biological aspects of the screens for OTEC intake systems. Final report, September 15, 1976-September 14, 1977.** Nath, J.H.; Miller, C.B.; Ambler, J.W.; Hansen, R.M. (Oregon State Univ., Corvallis (USA)). Sep 1977. Contract EY-76-S-06-2227-026. 147p. (RLO—2227/T26-2). Dep. NTIS, PC A07/MF A01.

The Ocean Thermal Energy Conversion concept requires large quantities of warm surface water and cold deep water to be passed through heat exchangers. The water intakes can suck in large quantities of fish, plant life and debris. This material must not be allowed to clog the heat exchangers; so, it must be screened and removed from the fluid flow, continuously, somewhere between the water intakes and the heat exchangers. It is recommended to provide sumps upstream from the pumps for both the warm and cold water circuits. State of the art traveling screens can be selected as standard items to operate in the sumps. Material that lodges on the screens can be removed almost continuously, stored, processed and taken to another location for disposal. Large opening gratings should be installed at the water intakes to keep out large animals. A deep ocean

fish sampler is recommended for surveying the types of fish and material that will present a problem to OTEC plants, in an economical way, with fluid flow patterns that will approximate an OTEC plant at smaller scale. A general survey is presented of the biological organisms to be encountered by OTEC plants in geographical regions that are candidate areas for such plants.

4225 (EPRI-ER—1113-SR) **Ocean thermal energy conversion: a state-of-the-art study.** Carmichael, A.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Ocean Engineering). Jul 1979. 84p. Dep. NTIS, PC A05/MF A01.

A baseline OTEC unit composed of eight 50 MW power modules (400 MW nominal power output) placed on a floating platform was defined to provide a focus for the study. The site assumed for the baseline system was about 85 nautical miles off the coast near New Orleans, Louisiana. The OTEC system is technically feasible and could operate year round in some regions of the Gulf of Mexico, off Hawaii, and off Puerto Rico. The closed Rankine cycle using ammonia as the working fluid is probably the best power plant system to utilize the small temperature differences of about 40°F between the warm surface water and the cold water taken from a depth of about 3280 ft (1000 meters). The most important components in the power plant are the large heat exchangers, and the major technical problems are anticipated with these components. The heat exchangers will be subject to biofouling, corrosion, and erosion. The platform will probably have a ship or barge configuration with the long cold water pipe supported from the midships region. The most important technical problems with the platform are associated with the influence of the ocean waves and currents on the combined platform, cold water pipe, and moorings. The estimated costs of the baseline system were established from recent design studies. The total capital investment (excluding the cables to shore) was estimated to be about $3000 per kW. This figure although more realistic than earlier cost figures is not firm because of the many technical problems that must be solved.

4226 (PB—294232) **Ocean thermal and current structures in the tropical South Atlantic relative to the placement of a grazing OTEC plant. Technical memo.** Molinari, R.L.; Chew, F. (National Oceanic and Atmospheric Administration, Miami, FL (USA). Atlantic Oceanographic and Meteorological Labs.). Jan 1979. 68p. NTIS PC A04/MF A01.

The results of the first stage of a multi-stage effort designed to provide ocean thermal and velocity data in the tropical South Atlantic for OTEC is presented. The tropical South Atlantic is one of several areas under consideration for placement of a grazing OTEC plant. In contrast to the moored OTEC plant, a grazing plant can take an active role in acquiring the thermal resource needed to drive the power plant. Because of the ability for self-propulsion, the data requirements for a grazing plant are somewhat different than those for a moored plant. In particular, data are required over a larger spatial area than those in the moored case with knowledge of the details of the horizontal distributions of temperature and velocity as important as data on the vertical distribution. These data requirements are reviewed, with particular reference given both to the importance of advection versus local heating effects in determining the thermal resource in the tropics, and how the relative importance of these effects impacts upon the OTEC operation.

SOLAR RADIATION UTILIZATION

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 4158, 4167, 4442, 4444, 4603, 4604

4227 (ANL/EES-TM—66(Vol.1)) **Hydride heat pump. Volume I. Users manual for HYCSOS system design program.** Gorman, R.; Moritz, P. (Argonne National Lab., IL (USA)). May 1978. Contract W-31-109-ENG-38. 95p. Dep. NTIS, PC A05/MF A01.

A method for the design and costing of a metal hydride heat pump for residential use and a computer program, HYCSOS, which automates that method are described. The system analyzed is one in which a metal hydride heat pump can provide space heating and space cooling powered by energy from solar collectors and electric power generated from solar energy. The principles and basic design of the system are presented, and the computer program is described giving detailed design and performance equations used in the program. The operation of the program is explained, and a sample run is presented. This computer program is part of an effort to design, cost, and evaluate a hydride heat pump for residential use. The computer program is written in standard Fortran IV and was run on a CDC Cyber 74 and Cyber 174 computer. A listing of the program is included as an appendix. This report is Volume 1 of a two-volume document.

4228 (CONF-780983—) **Proceedings of 3rd annual solar heating and cooling Research and Development Branch contractors' meeting.** (Department of Energy, Washington, DC (USA). Div. of Solar Applications Developments). Mar 1979. 541p. Dep. NTIS, PC A23/MF A01.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Abstracts were prepared for approximately 175 of the included papers. Some abstracts were entered into the GAP data base; four were included in EAPA.. (MOW)

4229 (CONF-780983—, pp 238) **Development of a solar driven free piston dual loop heat pump.** Shelton, S.V. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4230 (CONF-780983—, pp 239-240) **Development of solar heat pumps for the heating and cooling of buildings.** Jaster, H. (General Electric Co., Schenectady, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Solar assisted heat pumps (SAHP) are potentially the most cost-effective solar heating and cooling systems. Under contract General Electric Company will determine the best SAHP system. The decision will be based upon the results of a careful study of SAHP systems. The systems study constitutes the first phase of this contract. General Electric will then design, fabricate and test a prototypical heat pump subsystem optimized to operate within the chosen SAHP system.

4231 (CONF-780983—, pp 241-243) **Phase II Phoenix/City of Colorado Springs solar assisted heat pump project.** Jardine, D.M. (Kaman Sciences Corp., Colorado Springs). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The object of this study is to design, develop, and commercialize a preferred solar heating and cooling (SHAC) system which meets the following criteria: (1) the preferred SHAC system will be competitive in reliability and life cycle cost with all other competing systems; (2) the preferred thermal system will be compatible with the interfaced utility and the load to be served; and (3) the preferred thermal system will have a high overall net energy characteristic.

4232 (CONF-780983—, pp 244-245) **Development of a solar assisted heat pump for the heating and cooling of buildings.** Ecker, A.L. (Northrup, Inc., Hutchins, TX). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this Solar Assisted Heat Pump (SAHP) Development Program is to analyze, design, fabricate and test advanced high performance heat pumps and the related system hardware necessary for producing an economically justifiable, and hence, marketable SAHP system. In addition to the engineering development work, detailed plans will be assembled for producing and marketing these systems. The scope of the design effort includes the formulation of SAHP system designs for the residential, multi-family and commercial building schemes and, as such, will include the design of systems sized from one ton through twenty-five tons.

4233 (CONF-780983—, pp 246-249) **Design and field testing of solar-assisted earth coils.** Bose, J.E. (Oklahoma State Univ., Stillwater). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective is to design and operate a set of instrumented field experiments to obtain engineering information and data needed for optimum design of ground energy coupling devices for use in solar-assisted heat pump systems. The field experiment addresses energy coupling configurations for both horizontal pipes in trenches and vertical coils or geothermal wells. Procedures are to be developed to determine the proper balance between what is collected and stored in the ground, rejected to the ground, and extracted from the ground by the heat pump.

4234 (CONF-780983—, pp 250-254) **SAHP-2: analytical selection of marketable SAHP systems.** Kahan, W. (Singer Co., Fairfield, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The program objective is to identify the configurations of solar assisted heat pump (SAHP) systems and associated components that have the best market potential for the various climate regions of the United States, the primary criterion for best marketability being lowest life cycle cost relative to alternative systems. To achieve the program objective, SAHP systems with components that are based upon mature technology will be examined for application to single family residences, multiple family residences, and commercial buildings. For each of these building types, SAHP configurations suitable for new structures as well as configurations suitable for retrofit application are to be evaluated for their marketability.

4235 (CONF-780983—, pp 255-256) **Commercial building unitary heat pump system with solar heating.** Drucker, E.E. (Syracuse Univ., NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project is to further explore systems which combine water source heat pumps and water cooled solar collectors in intermediate sized buildings. A second goal is to evaluate the potential of air-to-air heat pumps with volume solar collectors for residential buildings.

4236 (CONF-780983—, pp 261-267) **Development of solar desiccant dehumidifier.** Gunderson, M.E. (AiResearch Manufacturing Co., Torrence, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This program is aimed at the development of a solar desiccant dehumidifier featuring a rotary bed of granular silica gel and a rotary regenerator. This dehumidifier can be used for air conditioning through adiabatic saturation of the process air stream.

4237 (CONF-780983—, pp 268-270) **Solar powered Rankine heat pump: a progress report.** Susag, R.W.; Benson, P.A. (AiResearch Manufacturing Co., Torrence, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This paper presents a brief description of the solar-powered Rankine cycle heat pump and an outline of the latest six-month progress of the AiResearch Manufacturing Company of California, Solar Heating and Cooling Project, on NASA Contract Number NAS8-32091.

4238 (CONF-780983—, pp 271-273) **Unitary solar heating/cooling system package development.** Merrick, R.H. (Arkla Industries Inc., Evansville, IN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this study is to develop 3 ton residential and 25 ton commercial unitary solar heating and cooling system hardware and software.

4239 (CONF-780983—, pp 274-275) **Engineering design construction and testing of a salt-water absorption unit optimized for use with a solar collector heat source.** Merrick, R.H. (Arkla Industries Inc., Evansville, IN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The object of this study is to develop a 3 ton direct evaporatively cooled Li-Br absorption chiller suitable for use with flat plate collectors.

4240 (CONF-780983—, pp 276-278) **Development of a single family absorption chiller.** Biermann, W.J. (Carrier Corp., Syracuse, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the program is the design, construction and testing of a potentially marketable, air cooled, absorption chiller of about 10 kW (3 tons) capacity, capable of being powered by solar collectors of types presently commercial.

4241 (CONF-780983—, pp 279-280) **Development of a high temperature solar powered water chiller.** English, R.A. (Carrier Corp., Syracuse, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Carrier is under contract to DOE to design, construct, and test an air cooled water chiller in the 15 to 25 ton size range. The chiller is to be designed for efficient operation with solar heated fluid supply temperatures between 220°F and 300°F. Carrier is the prime contractor, with Mechanical Technology, Inc. of Latham, New York, as subcontractor, to design and build the turbo machine subsystem.

4242 (CONF-780983—, pp 281-282) **Design of a solar air conditioner using a solid phase absorber.** Offenhartz, P.O'D. (EIC Corp., Newton, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this contract is to design, construct, and test a solar air conditioner based on solid-phase absorption. The absorber is to be a low-cost inorganic salt, which provides air conditioning by reacting with water vapor. The thermodynamics and kinetics of reaction are to be chosen such that dry-air heat rejection can be accomplished while maintaining relatively low solar collector temperatures and a coefficient of performance above 0.6. Sufficient thermal storage is to be provided in the dehydrated absorber to permit essentially 100% solar operation, without utility backup.

4243 (CONF-780983—, pp 283-284) **Solar steam engine for Rankine cooling.** Martin, C.G.; Kolenc, T. (Energy Technology Inc., Cleveland, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

ETI is currently developing under contract to DOE, a high efficiency steam turbine to be utilized as a primemover for solar powered air-conditioning. This turbine, in conjunction with an ETI patented hybrid Rankine cycle, will provide the potential to reduce the collector requirement for space cooling by a factor of 2 to 3 over units previously demonstrated.

4244 (CONF-780983—, pp 285-286) **Solar heating and cooling design and development.** Graf, J.C. (General Electric Co., Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project, a part of the Marshall Space Flight Center program for the development of solar heating and combined solar heating and cooling systems, involves the complete design and development of marketable systems for single family and commercial applications and the delivery, installation, and monitoring of prototype systems. The development of the two types of systems is proceeding in parallel with selected commonality of system elements. The time required for the development of the combined heating and cooling systems is greater than for the heating systems, so the heating systems are being installed while development of the cooling subsystem continues.

4245 (CONF-780983—, pp 287) **Solar-powered cooling of buildings.** Curran, H.M. (Hittman Associates, Inc., Columbia, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The project objectives were (1) to provide input for the development of the National Program Plan for Solar Cooling of Buildings, and (2) provide technical assistance in the evaluation of the NASA 404 Solar Cooling Projects.

4246 (CONF-780983—, pp 288-290) **Design and development of single family, multifamily, light commercial and commercial size solar heating, cooling and hot water systems.** Merrill, G. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Honeywell entered into a contract agreement with NASA Marshall Space Flight Center at Huntsville, Alabama, in July of 1976 to design and develop solar heating and cooling systems which have high performance, low cost, modular in application and are developed to a marketable state. Honeywell is the prime contractor with Barber Nichols Engineering of Denver, Colorado, and Lennox Industries of Marshalltown, Iowa, as subcontractors. Honeywell is responsible for the solar system design and program management subcontractor coordination efforts. Barber Nichols and Lennox are working as a team to develop solar-powered Rankine engine/air conditioner subsystems. Lennox Industries is supplying HVAC products suitable for application in the system, including their production flat plate collector. The contract calls for delivery of the following systems: 2 - Residential heating; 2 - Residential heating/cooling; 1 - 25-Ton Multifamily heating/cooling; 1 - 25-Ton commercial heating/cooling; 1 - 50-Ton commercial heating/cooling; 1 - 75-Ton commercial heating/cooling.

4247 (CONF-780983—, pp 296-297) **Development of solar-MEC heating/cooling system.** Macriss,R.A.; Wurm, J. (Institute of Gas Tech., Chicago, IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4248 (CONF-780983—, pp 298) **Development of new fluids for solar-absorption cooling.** Macriss, R.A.; Zawacki, T.S. (Institute of Gas Tech., Chicago, IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4249 (CONF-780983—, pp 299-301) **Development of solar-driven ammonia-water absorption air conditioners and heat-pumps.** Dao, K.; Wolgast, R.; Wahlig, M. (Lawrence Berkeley Lab., CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the development of absorption refrigeration systems for solar heating and cooling applications. Absorption cycles under investigation are: the basic single-effect cycle operating with low heat source temperatures compatible with flat plate collectors, and advanced multi-stage cycles operating with high heat source temperatures compatible with concentrating collectors for higher COP (coefficient of performance).

4250 (CONF-780983—, pp 305-306) **Solar cooling component modeling and optimization.** Allen, R.W.; Anand, D.K. (Univ. of Maryland, College Park). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the research is threefold, namely, to develop cooling machine component models for use in detailed as well as simplified simulations for predicting cooling system performance, to develop simplified cooling system performance programs including the study of control strategies, and to model weather via stochastic algorithms for use in quick design procedures.

4251 (CONF-780983—, pp 307-309) **Chiller driven by a solar steam-powered Rankine engine (SSPRE).** Lior, N.; Yeh, H. (Univ. of Pennsylvania, Philadelphia). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the design, fabrication, testing and analysis of a solar-powered heat engine/vapor compression cycle chiller of 15 to 25 ton capacity. The chiller shall be designed for efficient operation with solar-heated fluid supply temperatures of 220° to 300°F and be air-cooled.

4252 (CONF-780983—, pp 310-311) **Development of an integrated single family size air based solar heating and domestic water heating system using either a desiccant or a heat pump based cooling system.** Shaw, L.E. (Solaron Corp., Denver, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this program is to make parallel analyses of combined air based solar-heat pump and solar-desiccant systems. These analyses are made to determine which of the systems considered would offer the best opportunity to save energy for space heating, domestic water heating, space cooling and for combined heating, water heating and cooling. The system which offers the best overall performance (i.e., uses the least auxiliary energy) will then be installed in two single family dwellings selected by NASA. The performance of these two installations will be monitored by NASA/MSFC and the results reported by them. Due to the relatively short duration of the study and the requirement to install two working systems, it was necessary to restrict the analyses to systems using presently available hardware.

4253 (CONF-780983—, pp 312-315) **Design, development and testing of a prototype multi-family residential sized solar-powered turbocompressor heat pump system.** Biancardi, F.R. (United Technologies Research Center, East Hartford, CT); Young, P. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A prototype solar-powered turbocompressor heat pump system for multi-family residential applications is being designed, fabricated and tested. The program will also define the specifications for limited production units for use in the DOE Solar Heating and Cooling Demonstration Program. The prototype system will incorporate a new turbocompressor designed to operate at temperatures consistent with medium-concentration collectors and will utilize heat exchanger and turbocompressor system design data developed by United Technologies under prior DOE-sponsored programs.

4254 (CONF-780983—, pp 316-319) **Overview of the DOE passive solar heating program.** Perry, J.E. Jr. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A current look at passive solar heating and cooling work shows a wide spectrum of activities. These include: fundamental measurements on new or old passive structures; mathematical modeling of passive systems to promote understanding, allow extrapolation, and facilitate design; materials development; early attempts at product design for commercialization; and finally, economic studies. Of necessity, the current primary emphasis involves the understanding of how passive systems work, and how one can design them, while secondary emphasis is properly placed at the moment on commercialization and economics. The transition to commercialization is being pushed as rapidly as possible, but the success of commercialization must follow the development of understanding. In this paper a review of current passive heating grants and contracts will be given. Natural cooling techniques are the province of the Lawrence Berkeley Laboratory.

4255 (CONF-780983—, pp 322-323) **Lindberg residence.** Pfister, P. (Architectural Alliance, Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The Department of Energy awarded the Architectural Alliance a PRDA-5 grant in October, 1977 to design, construct, instrument and monitor a hybrid solar system in a residence designed for Mr. & Mrs. Charles Lindeberg. The system was to utilize both standard and innovative building components to achieve passive solar collection, storage, and distribution. The objective was to establish the contribution of a hybrid solar system to annual heating and cooling loads of a typical residence and to assess the performance of various system components.

4256 (CONF-780983—, pp 324-325) **White Mountain School living center, Littleton, New Hampshire.** White, C.S. Jr. (Banwell White & Arnold, Inc., Hanover, NH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project is for dormitory and faculty housing at the White Mountain School in Littleton, NH. The school building program began with the premise that the building should be a living center that extends the educational experience beyond the classroom. The most relevant way to accomplish this, it was felt, was to place the students in contact with a natural energy system, simple in design and operation, yet effective in terms of fossil fuel savings. With this in mind, a solarium/greenhouse design was selected.

4257 (CONF-780983—, pp 326-327) **Evaluation of heat pipe applications for passive solar heating systems.** Corliss, J.M. (Battelle Columbus Labs., OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this research program are (1) to determine the potential utility and cost effectiveness of the application of heat pipe principles to heat transfer in passive solar systems, and (2) to develop heat pipe techniques, i.e., phase change, evaporation/condensation heat transfer, convective transport, and capillary pumping to enhance the system component performance as part of a passive heating and/or cooling system.

4258 (CONF-780983—, pp 328-332) **Impact of controls on back-up energy consumption in passive solar heated and cooled residences.** Sebald, A.V.; Clinton, J.R. (Univ. of California, San Diego). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to evaluate the performance benefits associated with various control techniques applied to generic passive solar heating and cooling systems. Both manual and automatic controls are examined using hour-by-hour year long computer modelling techniques. The term control is used in a general sense and includes building component parameters as well as vents, moveable insulation, thermostatically controlled fans, etc.

4259 (CONF-780983—, pp 333-335) **Application of phase change materials in passive systems.** Sliwkowski, J. (Inst. of Energy Conversion, Wilmington, DE). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this study is to develop an integrated solar energy collection and thermal storage unit applicable to both new and retrofit construction for hybrid solar application. The concept of the Thermal Wall Panel (TWP) is the use of a phase change material. The TWP has an incremental cost objective of $5.00 to $7.00 per square foot of glazing with an associated payback period of 7 to 10 years.

4260 (CONF-780983—, pp 336-338) **Suncatcher monitoring project.** Maeda, B.T. (Earth Integral of Living Systems, Winters, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purpose of this grant was to monitor an innovative passive solar house design to gather both intensive and extensive data on the performance of the passive solar hot water system, the solar space heating system, and the natural cooling system. This data is being gathered to increase the knowledge of passive solar performance and to evaluate computer estimation and simulation of total systems and subsystems, in particular the Suncatcher reflective system.

4261 (CONF-780983—, pp 339-340) **Passive solar energy collector.** Hauer, C.R.; Bryant, B.W. (Eikonix Corp., Burlington, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this research program was to establish the practicality of using Poroplastic filled with wax and other wax filled plastic host materials as volumetric absorbers and storers of solar energy. The program also sought to show that a passive solar collector/convector of the Trombe Wall type can store a meaningful amount of heat and can be fabricated from these materials. The specific objectives were to demonstrate that Poroplastic/wax sheets could be made using paraffin, stearic acid, cetyl alcohol or other low melting - temperature waxes, and that these poroplastic/wax sheets could absorb solar energy effectively and store a meaningful amount of thermal energy as latent heat of fusion.

4262 (CONF-780983—, pp 341-342) **Experimental investigation of the Trombe wall passive solar energy system.** Casperson, R.L. (Energy Engineering Group, Inc., Idaho Springs, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project entails experimental research on the operating performance of the Trombe wall type of passive solar energy system. The emphasis in the project is on the thermo-circulation behavior of the Trombe wall proper. Detailed solar radiation data, concrete wall temperature distributions, and wall gap air temperature and velocity profiles will be obtained.

4263 (CONF-780983—, pp 343-346) **Development of a low-cost, modular controllable-passive solar furnace.** Keller, B.M. (Kalwall Corp., Manchester, NH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project was to develop a new and innovative concept of a modular controllable passive Solar Furnace which would: (1) supply controllable passive solar energy for residential and commercial space heating; (2) provide space heat at the lowest possible cost per Btu; (3) be reliable and maintenance-free with simple controls; and (4) eliminate the need for a high degree of architectural integration with the rest of the building.

4264 (CONF-780983—, pp 349-351) **Passive solar analysis and design.** Kammerud, R.; Place, W.; Borgers, T.; Andersson, B. (Lawrence Berkeley Lab., CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The passive solar program at Lawrence Berkeley Laboratory includes projects which range from thermal modelling to conceptual design of passive structures. The work emphasizes large-scale passive systems such as might be found in commercial building heating or cooling applications. The objectives of the work are: (1) to explore potentials for passive solar in non-residential construction; (2) to develop and evaluate design concepts for large-scale passive systems; (3) to develop thermal models for passive solar heating and cooling systems; and (4) to incorporate the models into existing, public domain building energy analysis computer programs (BLAST and DOE-1) and to document and release them to the building design and engineering community.

4265 (CONF-780983—, pp 352-353) **Passive integrated heating and cooling system designed by Living Systems.** Hammond, J. (Living Systems, Winters, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The project's objectives are threefold: first to research and develop solar components in order to design and construct inexpensive mass storage units, efficient solar collection systems, a cost effective movable insulation system, and a powerful cooling system with on moving parts; second, to develop computer modelling capabilities for prediction of passive system performance; third to prepare a preliminary architectural design for a rural community center, integrating the afore mentioned components into the building.

4266 (CONF-780983—, pp 354-355) **Retrofit of an existing masonry home for solar passive space heating.** Michels, T.I. (Londe-Parker-Michels, Inc., St. Louis, MO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary purpose of this project is to demonstrate the technical feasibility of Passive Solar Space Heating Retrofit as it might apply to the existing masonry housing stock. Secondary goals include establishing the economics of such a retrofit, developing a low cost analog to digital data recording system and acquiring extensive data on the thermal performance characteristics of the demonstration. A future goal is to reduce this data and data from other projects to Passive Architectural Design Principals.

4267 (CONF-780983—, pp 356-366) **Los Alamos Passive Solar Program.** Perry, J.E. Jr. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The basis for the Los Alamos Passive Solar Heating Program is the concept that one must develop a quantitative understanding of how passive systems respond to sun and weather in a given location in order to predict how these systems will behave in other locations. To accomplish this objective three types of technical activity have been undertaken. (1) Fourteen test rooms have been built, instrumented, equipped with various passive features, and monitored through one heating season. (2) Fifteen buildings have been instrumented and monitored for almost a year. (3) The previously-validated storage-wall digital computer code PASOLE has been used to calculate many features of storage-wall operation throughout the United States and to generate simplified techniques of predicting storage-wall performance. It has been extended to cover south greenhouse and direct gain passive systems. A summary of the technical aspects of the passive solar program at Los Alamos is presented.

4268 (CONF-780983—, pp 367-368) **Performance analysis of thermic diode solar panels.** Buckley, S. (Massachusetts Inst. of Technology, Cambridge). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Thermic diode solar panels, a modular passive solar heating panel working on the thermosyphon principle, was analyzed for yearly performance. Two objectives were sought: (1) verification of computer models against experimental data, and (2) use of the computer codes to develop a design manual. The computer simulation was to be verified for full-size panels under actual operating conditions. Using the verified computer model, a building installation of the panel was to be simulated for various weather conditions, orientation, building load and panel parameters on an hourly basis for a year. The simulation results were to be correlated to produce a design manual to allow quick design of a thermic diode space heating system.

4269 (CONF-780983—, pp 369-372) **Design methodologies for energy conservation and passive heating of buildings utilizing improved building components.** Johnson, T.E. (Massachusetts Inst. of Technology, Cambridge). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The recently completed MIT Solar Building 5 has shown the problems associated with direct gain approaches can be overcome with new architctural finish materials that emphasize their thermophysical properties. Three new materials are demonstrated in the building: (1) a transparent window insulation, (2) a glare modulating and light directing louver, and (3) a ceiling tile that stores heat latently.

4270 (CONF-780983—, pp 373) **Analysis of performance of passive solar heated nature center.** Moore, F. (Miami Univ., Oxford, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to instrument, monitor and analyze the thermal performance of the passive solar heated Patoka Interpretative Nature Center Building located in Orange County, Indiana, and report these findings.

4271 (CONF-780983—, pp 374-377) **Passive solar data requirements.** Ducas, W.; Streed, E.R.; Hill, J.E. (National Bureau of Standards, Washington, DC). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purpose of this project is to develop standard procedures for the systematic characterization, instrumentation, evaluation, and reporting of the thermal performance of passively solar-heated and/or cooled buildings. (MOW)

4272 (CONF-780983—, pp 378-379) **Performance evaluation of a passively heated and cooled house.** Mancini, T.R. (New Mexico State Univ., Las Cruces). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this project are to build and evaluate the performance of a SKYTHERM house located on the campus of New Mexico State University in Las Cruces, New Mexico. The hot climate of Southern New Mexico offers a unique opportunity to fully evaluate the cooling capabilities of the SKYTHERM concept of environmental control. In addition the existence of an actively heated and cooled house adjacent to the passive house permits the direct comparison of the two systems.

4273 (CONF-780983—, pp 380-381) **Investigation of storage requirements for passive solar heating systems based on local weather characteristics.** Bahm, R.J. (Univ. of New Mexico, Albuquerque). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the work to be performed under this contract is to: (1) develop a correlating parameter or parameters for determining from available weather data the size of storage in passive solar space heating systems; and (2) develop methods for computing the effect of storage size on system thermal performance in a particular solar environment.

4274 (CONF-780983—, pp 382-383) **Design, fabrication and testing of a marketable modular waterwall component.** Maloney, T.J. (One Design, Inc., Winchester, VA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4275 (CONF-780983—, pp 384-385) **Focusing roof aperture and water-wall passive solar building experiment.** Fraker, H. Jr. (Princeton Energy Group, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of the Building Experiment are: (1) to test the performance of a combination water-wall and focusing roof aperture passive solar heating system; (2) to develop and evaluate calculation procedures for predicting performance (both detailed computer simulation and hand calculator programs); and (3) to conduct a detailed evaluation of design alternatives for the focusing roof aperture to try and answer the following questions: is focusing necessary and how much; can focusing be achieved economically and aesthetically; what is the optimum type and configuration of storage, i.e., should it be concentrated or distributed, or is some combination of concentration and distribution preferable.

4276 (CONF-780983—, pp 386-387) **Evaluation of energy flow control techniques for passive heating and cooling systems.** Kroner, W.; Tichy, J. (Rensselaer Polytechnic Inst., Troy, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives are: (1) to identify and select a number of different types of passive solar systems (PSS) projects in various climatic regions; (2) to obtain thermal, architectural and economic data on the performance of energy flow controls (EFC) associated with the selected PSS; (3) assess the performance of EFC's in terms of their thermal characteristics, impact on the sensory environment, energy savings and building cost; (4) document the results in terms of thermal effectiveness, economies, and architectural impact; and (5) recommended additional EFC research where appropriate.

4277 (CONF-780983—, pp 388-391) **I. Skytherm design evaluation. II. Skytherm production research.** Hay, H.R. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Two projects, concurrent and mutually supportive, will move Skytherm Southwest Natural Heating and Cooling from successful prototype demonstration toward commercialization. Component improvement and testing for prefabrication and on-site assembly will permit regional cost analysis and acceptance with the aid of a manual on system design and installation. Two demonstration houses will be completed. Materials and certification constraints will be removed and the concept will be extended to new applications. Prefabrication and marketing studies will prepare the system for commercial promotion.

4278 (CONF-780983—, pp 392-393) **Performance analysis of a double polyethylene inflated hybrid solar space heating system.** Kenin, S.R. (Solar Room Co., Taos, NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The program's objectives were to collect controlled experimental data on the performance and cost-effectiveness of the Solar Room, and to evaluate subjective user experience which estimated solar fractions to be within a 30 to 60% range. The Solar Room is a double-polyethylene inflated south wall glazing system that was designed as a low cost, retrofit collector for low and middle income homes that would have minimum impact on the aesthetics and structure of the house. The evolved structure looks somewhat like a lean-to greenhouse, though this was not the original purpose and the collection system should not be confused with a typical lean-to greenhouse.

4279 (CONF-780983—, pp 384-295) **Integration and validation of the DEROB and PASOLE computer programs for the simulation of passive solar heating and cooling buildings.** Arumi, F.N. (Univ. of Texas, Austin). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to provide a public domain computer program capable of aiding in the design and in the evaluation of passive energy buildings. This FORTRAN IV program, which will be accessed through batch processing, will be based on the concepts developed by the Los Alamos Scientific Laboratory (LASL) for RC Network Solutions (Program PASOLE) and by the University of Texas for the generalized interface between architectural elements and the design of the RC Network (DEROB).

4280 (CONF-780983—, pp 396-400) **Regional assessment of evaporative, radiative and convective cooling processes and systems in the United States.** Clark, G.; Allen, C.; Loxsom, F.; Treat, C.H. (Trinity Univ., San Antonio, TX). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

All cooling systems ultimately discharge heat to the environment by some combination of the natural or passive cooling processes; evaporation, radiation and convection. In this project we shall perform a regional assessment of natural process heat dissipation rates. A variety of glazed and tilted heat dissipation surfaces will be considered, but special attention will be given to unglazed, horizontal, wet and dry surfaces. The project also includes a feasibility assessment of natural cooling systems for residences. A detailed performance analysis will be conducted for naturally cooled residences utilizing roof-ponds, plastic and glass glazed tilted surfaces and rock bins.

4281 (CONF-780983—, pp 401-402) **Solar atrium: a hybrid solar heating and cooling system.** Ueland, M. (Ueland and Junker, Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to develop and test a concept for solar heating and cooling of houses and buildings that has wide application to building design and is cost-effective to install and operate. The concept is called solar atrium. It consists of a solar room with integral thermal storage and other equipment designed to collect and store solar heat and to assist in summer cooling. Cost objectives are to achieve fuel cost reduction over comparable conventional buildings sufficient to amortize initial investment in solar equipment in ten years or less.

4282 (CONF-780983—, pp 403-407) **Passive retrofit research on an existing dwelling.** Wessling, F.C. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purposes of this grant were to design, fabricate, and test four passively heated and six passively cooled test modules of different design. These were built to interact with an existing frame stucco dwelling in Albuquerque, New Mexico. Further objectives were (1) to perform intensive testing of the various modules utilizing a digitial data acquisition system and appropriate instrumentation, (2) to perform computer modeling and digital data analysis of the various modules, and to (3) perform long-term data collection utilizing appropriate instrumentation.

4283 (CONF-780983—, pp 408-409) **Nocturnal air cooling system for non-residential buildings.** Yu, Y.N. (Ying Mfg. Corp., Gardenia, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The system intended for non-residential buildings is currently being built in a simulated building module. Unwanted building heat will be dumped by radiation and evaporation to the night sky (terrestrial radiation) through exterior metal sills and the coolth stored in the building structural floor slabs for cooling use the next day.

4284 (CONF-780983—, pp 410-414) **Systems analysis/validation for solar applications (SAVSA).** Bishop, C.J. (Solar Energy Research Inst., Golden, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This paper serves two purposes: (1) an overview of the Systems Analysis/Validation for Solar Application (SAVSA) program, and the role of the Solar Energy Research Institute (SERI); and (2) a review of work performed by organizations not making specific presentations at the R & D review.

4285 (CONF-780983—, pp 415-416) **Evaluation of a residential solar air heating and nocturnal cooling system.** Karaki, S. (Colorado State Univ., Ft. Collins). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of the project are to (1) determine and evaluate seasonal performance of a solar air-heating system for space and water-heating and a nocturnal cooling system for space cooling; (2) improve the operation of the system as determined from data analysis; (3) assess the performance of an air-heating solar system with a parallel heat pump; (4) compare the air-heating solar system in Solar House II with the liquid-heating solar systems in Solar House I; (5) evaluate a heat pump system using the pebble bed storage for cold charge; and (6) compare cool storage and direct cooling with a heat pump.

4286 (CONF-780983—, pp 417) **Cost-effective ways to improve the fabrication and installation of solar heating and cooling systems for residences.** Thayer, S.B. (Colorado State Univ., Ft. Collins). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of the study are to identify cost-effective ways to improve the fabrication and installation of solar heating and cooling systems for residential applications.

4287 (CONF-780983—, pp 418-421) **Evaluation of a residential solar heating and cooling system-CSU Solar House III.** Ward, D.S. (Colorado State Univ., Ft. Collins). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project is to test and evaluate the practicality of an integrated solar heating and cooling system in CSU Solar House III, which utilizes a state-of-the-art flat-plate solar collector with a Yazaki 2-ton Lithium Bromide absorption chiller and cool storage subsystem. The system will also incorporate a state-of-the-art heat pump and a Direct Contact, Liquid-Liquid heat Exchanger (DCLLHE) at later stages of the project, as separate, specific experiments. An additional objective is to compare system performance of the state-of-the-art liquid-heating flat-plate solar collector with an equivalent design of an air-heating collector, in order to provide a definitive statement on the relative performance of the liquid-heating and air-heating collectors and systems.

4288 (CONF-780983—, pp 422-426) **Evaluations of the evacuated tube collector systems on CSU Solar Houses I and III.** Lof, G.O.G.; Duff, W.S.; Conway, T.M. (Colorado State Univ., Ft. Collins). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of the two projects are (1) to evaluate the heating and cooling performance of residential-size solar systems with three different evacuated tube collectors, and two different lithium-bromide absorption chillers; (2) optimize the performance of the absorption chillers with and without cool storage; and (3) determine the operational characteristics of each system.

4289 (CONF-780983—, pp 427-428) **Development of integrated solar space heating system.** Christopher, J.C. (NASA, Huntsville, AL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The function of this program was to develop a marketable, builder ready, solar space heating system suitable for application in the temperate northern latitudes. The development included studies relating to thermal performance, structural integrity and durability, energy transfer and control systems.

4290 (CONF-780983—, pp 429) **Development of residential space and DHW solar system using air heating collectors.** Levine, P. (Fern Engineering Co., Inc., Bourne, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project was to complete development of a residential space and DHW Solar System using the Fern Engineering Company's design approach to a solar system that could be retrofit to existing homes. Development testing of the collectors and key components and certification of the safety of the collector installation at two sites and operational evaluation were all essential tasks in achieving the objective.

4291 (CONF-780983—, pp 430-431) **Solar heat for a manufactured home.** Scofield, M.P. (Idaho National Engineering Lab., Idaho Falls). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project is to design, build and test a commercial prototype of a solar heating option for a Boise Cascade manufactured home. Commercial viability requires that the performance of a solar heating system must provide positive monthly savings to the homeowner in comparison with com.nonly available heating fuels. Such a solar heating option is the ultimate goal of this project.

4292 (CONF-780983—, pp 436-437) **Instrumentation system for the Los Alamos National Security and Resources Study Center.** Murray, H.S.; Trump, M.A. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to provide an instrumentation and data acquisition system for the Los Alamos National Security and Resource Study Center (NSRSC). This system is required to allow a detailed study of the building's solar heating and cooling system performance.

4293 (CONF-780983—, pp 438-439) **SOLCOST maintenance and support proposal.** Giellis, R.T. (Martin Marietta Corp., Baltimore, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

SOLCOST, a digital computer tool for solar energy systems, was developed by Martin Marietta under contract to DOE. The SOLCOST Program computes an optimum solar collector area and tilt angle from an analysis of life cycle cost differences for a solar system versus a reference (conventional) HVAC system. The basic approach used is to perform one day-long computation for each month of the year. This computation utilizes historical weather data, including minimum temperatures, maximum temperatures, average degree days, and percent sunshine values. Some recent changes and improvements to the SOLCOST Program and the current availability of the SOLCOST Program are described.

4294 (CONF-780983—, pp 447-448) **Evaluation of the solar building, Albuquerque, NM.** Gilman, S.F. (Pennsylvania State Univ., University Park). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this project are to: (1) determine the actual performance characteristics of this office building system by analyzing field collected data; (2) develop a computer model of the test building and solar assisted heat pump heating systems; (3) correlate a period of field collected data results with the computer model to establish its validity; and (4) with the computer model, generate information for developing a System Design Handbook.

4295 (CONF-780983—, pp 449-450) **Studies and analyses for solar heating and cooling applications.** Lowery, G.W. (SAI, McLean, VA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The work to be completed under this project is directed at selecting those advanced solar energy heating and cooling systems which have the most potential for economical application throughout the country. The general objectives of the Project can be stated as follows: (1) identify, evaluate, and characterize, both from a technical and economical standpoint, advanced solar heating and cooling system and subsystem configurations for new and retrofit applications; (2) prepare recommendations, including supporting information, as to the type and extent of testing, which the Department of Energy should consider to prove-out the most promising systems and subsystems; and (3) identify the hardware and software for these systems that will require further technological development.

4296 (CONF-780983—, pp 451-452) **Simulation and design of solar thermal processes.** Duffie, J.A.; Beckman, W.A. (Univ. of Wisconsin, Madison). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the research is to develop simulation programs applicable to a variety of solar heating, cooling and other processes, to study heating and cooling systems using the simulation program, and to develop quick design methods for solar heating and cooling systems of standard configurations. The programs are to be documented, made available to others, and supported with services to holders.

4297 (CONF-780983—, pp 453-454) **Evaluation of performance, solar house heating system using pyramid optical condensing system.** Wormser, E.M. (Wormser Scientific Corp., Stamford, CT). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4298 (CONF-780983—, pp 457-458) **Performance evaluation of a proportional flow control system.** Herczfeld, P.R.; Fischl, R. (Drexel Univ., Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the work was to evaluate the proportional flow control system employed in the RKL solar heating and cooling demonstration project. Two subtasks were defined: (1) development of an accurate Proportional Flow Control (PFC) simulation model (by modifying the TRNSYS program) for the RKL system and its validation against the actual performance of the RKL system; and (2) evaluation of the proportional flow control device, i.e., the pinch valve.

4299 (CONF-780983—, pp 463-468) **Cost effective control systems for solar heating and cooling applications.** Pejsa, J.H. (Honeywell Energy Resources Center, Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this twelve-month contract work was to make recommendations toward cost effective control systems for six solar heating and cooling system applications. Preliminary to system performance evaluations on extensive survey of the literature and marketplace was conducted to ascertain the state-of-the-art as well as to anticipate new developments in control.

4300 (CONF-780983—, pp 469-470) **Solar energy management system (SEMS).** Moen, R.L. (Honeywell Energy Resources Center, Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4301 (CONF-780983—, pp 479-486) **Assessment of the need for new controllers.** Davis, A. (RHO Sigma, Tarzana, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this contract was to identify control-related impediments to the commercialization of solar energy systems. The final report on the work performed under this contract identified several areas where no government stimulus of control hardware development was needed. The final report also discussed the state-of-the-art of solar controls in certain key areas such as potable water heating, which may serve as a starting point in some systems analysis.

4302 (CONF-780983—, pp 487-488) **RS 600 microprocessor control system.** Peltzman, E.S. (RHO Sigma, Tarzana, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The object of this project is to develop a controller for complex solar heating and/or cooling systems. The controller must be adaptable to different types of systems with a minimum of hardware changes.

4303 (CONF-780983—, pp 489-491) **Two-stage approach to cost effective controllers via adaptive optimization.** Taylor, T.M. (Singer Co., Fairfield, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This report describes the results of a study to investigate the value of applying sophisticated controls to solar heating systems. A residential solar heating system utilizing a heat pump operating in the series-storage mode is considered and optimal control theory is used to derive a control strategy. The basic question addressed is how much of an improvement in efficiency can be gained relative to a conventionally designed controller, if an unrestricted control strategy is applied in an optimal fashion. The efficiency comparison is made on the basis of the amount of auxiliary energy required to attain an acceptable level of room temperature regulation. The second-order model for the system is derived using basic energy balance techniques and 4 control inputs are employed overall. The optimal control inputs are determined using Pontryagin's Maximum Principle which requires solution of a two-point boundary value problem. This is solved numerically using an iterative technique.

4304 (CONF-780983—, pp 492-493) **Assessment of need for new controllers.** Kent, T.B. (Solar Control Corp., Boulder, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this program is to determine if controllers not now commercially available should be developed for solar heating and cooling systems. There is an obvious need for new controllers, and the purpose is to identify what kinds of controllers are needed, how they fit into the solar system, and recommendations of control strategies which need to be developed. Most of the data were derived from a personal and mail survey of the suppliers and installers of solar systems. A questionnaire was generated to collect the pertinent data.

4305 (CONF-780983—, pp 494-496) **Development of a novel controller.** Kent, T.B. (Solar Control Corp., Boulder, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this program is to develop a high performance controller for solar heating and cooling applications. This will offer adaptive control of the solar system for optimal collection and distribution while maintaining home comfort levels. Also included are: applicability to both liquid and air transport systems, and variability of off-set and flow rates. Use of microprocessor logic base was investigated for cost effectiveness. The key novelty is the adaptive aspect which reduces duty cycle when high ambient levels exist, and reduces flow rate as load demand is satisfied.

4306 (COO—2858-24(Mgmt.Summ.)) **Residential solar heating and cooling using evacuated tube solar collectors: CSU Solar House III. Final report, management summary, February 1, 1976-September 30, 1978.** Ward, D.S.; Ward, J.C.; Oberoi, H.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Mar 1979. Contract EY-76-S-02-2858. 11p. Dep. NTIS, PC A02/MF A01.

The principal objective of the project is to test and evaluate the practicality of an integrated evacuated tube solar collector and absorption space cooling system installed in Colorado State University (CSU) Solar House III. This objective was to be accomplished by designing and installing a complete solar heating and cooling system (including appropriate instrumentation), performing detailed analysis and evaluation of all aspects of the system, and comparing seasonal performance with two other solar heating and cooling systems installed in adjacent buildings with virtually identical thermal characteristics. The two comparison system, installed in CSU Solar Houses I and II, consist of conventional solar water-heating and air-heating flat-plate collectors. The system in CSU Solar House III was comprised of a 48 m^2 (512 ft^2) liquid-heating evacuated tube solar collector array, 4550 liter (1200 gallon) thermal storage water tank, 7.03 kW (2-ton) lithium bromide absorption chiller, cool storage subsystem, and other components of the heating and cooling system.

4307 (COO—5054-1) **Northeast Carry Passive Solar Retrofit. Final technical report.** Poitras, R. (Northeast Carry, Hallowell, ME (USA)). 3 Aug 1979. Contract ET-78-F-02-5054. 2p. Dep. NTIS, PC A02/MF A01.

The Northeast Carry Passive Solar Greenhouse Retrofit is described. Specifications are given for the wall surface, collector area, and number of Btu's collected. Some estimates of systems efficiencies are given. (MOW)

4308 (DOE/NASA/CR—150706) **Ocmulgee National Monument Visitor Center solar heating and cooling system design review data.** (Honeywell, Inc., Minneapolis, MN (USA)). May 1978. Contract EX-76-A-29-1037. 72p. Dep. NTIS, PC A04/MF A01.

This document has been prepared as a part of the detailed design of the solar heating and cooling system to be installed at the Ocmulgee National Monument Visitor Center. It describes the 50 percent design review data for this site, and discusses the design approaches, system trade studies, subsystem design and development approach, solar collectors, preliminary specifications and other related information.

4309 (DOE/NASA/CR—150873) **Solar heating and cooling systems design and development. Quarterly report, 9 October 1976-9 January 1977.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Jan 1977. Contract EX-76-A-29-1037. 197p. Dep. NTIS, PC A09/MF A01.

Honeywell is to develop twelve prototype solar heating/cooling systems. Six of these are to be heating and six are to be heating/cooling systems, two each for single family, multi-family, and commercial applications. Schedules and technical discussions are given, along with illustrations on the progress made from October 9, 1976 through January 9, 1977.

4310 (DOE/NASA/CR—161273) **Solar energy system installed at the North Georgia APDC office building.** (North Georgia Area Planning and Development Commission, Dalton (USA)). Aug 1979. Contract EC-77-A-01-4075;EX-76-A-29-1024. 134p. Dep. NTIS, PC A07/MF A01.

Information is provided on the solar energy system installed in the newly constructed office building of the North Georgia Area Planning and Development Commission near downtown Dalton, Georgia. This solar heating, cooling and hot water system supplies 65 to 70% of the cooling demand and 90 to 95% of the heating demand. There are 2,001 square feet of effective Revere collector area, and the absorption chiller is in Arkla model 300 and provides 16 tons of cooling.

4311 (EMD—79-55) **Federal demonstrations of solar heating and cooling on private residences: only limited success.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 9 Oct 1979. 74p. General Accounting Office, 441 G St. NW, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

An analysis is provided of the residential solar heating and cooling demonstration program by the Department of Housing and Urban Development for the Department of Energy. Included are a perspective on the program, an evaluation of the success of the program in demonstrating solar heating systems, and a discussion on prospects for demonstrating solar cooling technologies. Actions are recommended to better ensure the practical operation of demonstration systems, provide adequate information for developing performance criteria, and improve program management. (MHR)

4312 (NMEI—17) **Perfomance evaluation of the New Mexico State University solar house. Final report, 1 January 1977-1 July 1978.** Mancini, T.R.; Smith, P.R. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). May 1979. 29p. New Mexico State Univ., Las Cruces, NM 88003.

The construction of the house and installation of the solar system were completed; the instrumentation system with the exception of the PDP 11/10 was installed; and a preliminary performance evaluation was performed. The 181 square meter (1950 square foot) Casa del Sol was designed in an energy efficient manner through the use of elements of passive solar system design, such as massive walls, exterior insulation, and shaded windows. The solar system is a liquid type in which a solution of water and propylene glycol is circulated through 69.7 square meters (750 square feet) of double glazed, flat plate solar collectors. The energy collected is transferred through a tube-in-shell heat exchanger and stored in the form of sensible heat in 7570 liters (2000 galons) of water in an insulated, buried storage tank. This energy is removed as required to heat, cool and provide

domestic hot water for the house. Since the PDP 11/10 minicomputer was not yet on line, the reduction of over 40,000 data points was done manually in the preliminary performance evaluation. During the evaluation period, the collector efficiency averaged 53% and the house was heated 100% with solar energy. In fact, the house was heated 98% with solar energy during the winter of 1976 to 1977.

4313 (SIB-R—108-1978) Basic conditions for solar space heating in Scandinavia: calculation methods, analysis of parameters, efficiency and optimization. Girdo, V. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). Nov 1978. 292p. (In Swedish). Dep. NTIS (US Sales Only), PC A13/MF A01.

Solar heating systems are discussed for Scandinavian climates. A method is described to calculate dimensions of the solar system, where a lot of parameters are varied. Both individual systems and large centrals are discussed. Experimental tests of flat solar collectors and comparisons to calculated efficiencies are also reported.

4314 Solar converter system with thermal overload protection. Popovich, J.M.; Thornbury, T.R. US Patent 4,169,460. 2 Oct 1979. Filed date 26 Jan 1977. 6p.

A solar energy conversion system comprises: (a) a solar converter in which liquid absorbs solar radiation, the liquid being solar energy absorptive; (b) first means to circulate said liquid for flow through the converter; and (c) means to effect removal of liquid from the converter in response to an undesirable operation condition in said system. 12 claims.

4315 Performance of an experimental regenerative-evaporative cooler compared with predictions. Buchberg, H.; Lassner, N. (Univ. of California, Los Angeles). pp 629-640 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Wasington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An experimental regenerative-evaporative cooling (REC) system has been designed, constructed and tested in the laboratory under simulated environmental conditions. It represents the first phase of an investigation of solar desiccant evaporative cooling processes applied to space cooling with the goal of substantial reduction in electric power usage for air-conditioning. The test measurements were used to validate and refine an analytical performance model programmed for computing. Performance graphs are generated which permit the determination of supply air temperature and room air temperature and humidity for a specified air flow, latent and sensible heat load and heat exchanger carryover ratio. Predictions of room air temperature (T1) are within 2°F or less and room air humidity ratio (W1) within 0.0008 lb/lb/sub a/ or less of observed performance. Supply air temperature (T10) was predicted within 1°F or less. Based on a design capacity of 3.5 tons of cooling at an air flow of 2500 cfm it is estimated that a cooling effect to electrical power usage ratio between 8 and 10 is achievable. The experimental system is capable of providing 3.5 tons of cooling when delivering air at 67.3°F when the outside air is at 100°F with humidity 0.0103 lb/lb/sub a/. For these conditions, 2500 cfm supply air maintains a room temperature of 77.6°F at 70% relative humidity when 1/3 of the load is latent heat.

4316 Open absorption system utilizing solar energy for air conditioning. Grossman, G.; Shwarts, I. (Israel Inst. of Tech., Haifa). pp 641-647 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Wasington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The possibility of providing the cooling needs of buildings by means of solar energy has a large potential for energy conservation. A number of solar air conditioning systems have been experimented with mostly relying on solar heat to power a closed absorption or a steam-ejector type cooling device. These systems normally have a low coefficient of performance when used with a low temperature heat source such as flat plate solar collectors. The present work is a study of an air conditioning system based on dehydration of the air in an open absorption system where the desiccant solution is regenerated by solar energy. Ambient air is dehydrated by means of the desiccant. The dry air is cooled back to ambient temperature by indirect heat exchange, then cooled further by combination of evaporative and mechanical cooling. The advantages of the system are that the energy to power the system can be supplied at temperatures not higher than 160°F, which are easily obtained with solar energy, and that the entire latent heat can be removed at temperatures of 85°F, compared with latent heat removal temperature 34 to 41°F in mechanical air-conditioning.

4317 Thermal processes of solar houses. Kimura, K.I. (Waseda Univ., Tokyo, Japan). pp 697-714 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An overview of the various thermal processes of solar house is described on the basis of experience in solar house design and building heat transfer studies. The relationship between solar radiation transmitted through windows and room air temperature variation is discussed with regard to the heat storage effect of building structure. Examples are presented on the performance evaluation of passive solar system. Practical problems on the system of space heating and hot water supply integrated each other are discussed including the problems of direct heating system versus heat pump assisted heating system.

4318 Some aspects of the role of solar radiation in determining dwelling heating and cooling energy requirements. Walsh, P.J. (CSIRO, Victoria, Australia). pp 737-748 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Every building acts as a solar collector. This paper describes and quantifies the so-called passive role played by incident solar energy in determining heating and cooling requirements for some typical Australian dwellings. Quantification is achieved through computer simulation of building thermal behaviour. The requirements for such a model, including climatic data input, are described in some detail. Use of the sol-air temperature and shading coefficient concepts enables the influences of solar radiation to be simulated. Since the necessary radiation measurements are often unavailable for a given location, various theoretical estimates have been investigated. In addition, the relative contributions of conduction and transmission solar heat gains have been examined for certain types of construction.

4319 Houses as passive solar collectors. Siviour, J.B. (Electricity Council Research Centre, Capenhurst, England). pp 749-759 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Measurements show houses to be solar collectors with efficiencies of 6 to 7% for space heating. The useful contribution amounts to 2000 to 3000 kWh/y, depending on the level of insulation. Calculations show that concentrating glazing as far as is reasonable in south-facing walls would increase the useful contribution by about 300 to 400 kWh/y. But even when south-facing, double glazing in winter loses more heat than the solar gain through it. Insulating shutters used when dark and on dull days would improve the heat balance.

4320 Dimensioning of a solar heating station. Svensson, C.A. (Sunvex Energi AB, Vaexjoe, Sweden). pp 803-812 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A solar heating station for Sweden is discussed as planned for district heating for 50 houses. The economy of a single heat storage tank is described. Heat losses and a cost analysis are calculated. (MHR)

4321 Solar radiation transmission and heat transfer through architectural windows. Viskanta, R.; Hirleman, E.D. (Purdue Univ., West Lafayette, IN). pp 869-882 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A detailed investigation of the thermal performance of architectural window systems has been undertaken. Unique aspects of the analysis included consideration of the spectral and directional nature of solar radiation transmission and thermal (longwave) radiation exchange processes of ordinary and radiation selective thin film coated glass window panes. Also, hourly meteorological and insolation data obtained from the US Weather Bureau were used in realistic predictions of the long-term energy transfer through several window design configurations for both summer and winter conditions. A number of window design parameters were investigated including multiple panes, gap spacings, filler gas thermal conductivity, window orientation and thin film coatings yielding high solar transmission but smultaneously high reflection in the thermal portion

of the spectrum. The computations indicated that double glazed windows can cut window heat losses by more than 50% over conventional single panes for a typical winter month in Sterling, Virginia (suburb of Washington, DC). Somewhat smaller reductions in window heat gain are possible for a typical summer month in Phoenix, Arizona. Our calculations also predicted that the use of advanced window systems utilizing one thin film coating on a double glazed window results in approximately a 70% reduction in window losses over conventional single panes for the winter season.

4322 Improved model for calculation of heat transfer due to solar radiation through windows. Kiss, L.I.; Benkoe, I. (Budapest Technical Univ., Hungary). pp 883-896 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The aim of work presented here was to construct a more reliable calculation procedure for the determination of input heat rate, applying the basic concepts of heat transfer consequently for single and double windows of different glass-types. Esperimental investigations were carried out on a small-size and on a bigger model, and also in a building. Spectral characteristics of different glasses were measured by spectro-photometers. Direct and diffuse radiation was determined by thermally compensated radiometers. Glasses in investigation were of different types: reflective, absorbing/coloured/, opaque and common ones. Different forms of heat transfer through windows were considered in detail/conduction in glass with non-zero absorbance or with a reflecting layer on one side, natural and forced convection regimes inside and outside, conduction and convection between panes, self-radiation of glass depending on its spectral characteristics etc./. After an order-of-magnitude analysis a so called two-line, two-band model was created. The system of equations was solved numerically, and the resulting radiative and convective heat fluxes were tabulated for a series of various thermal conditions. A set of nomograms was also worked out for practical design purposes. The results of calculations were checked by our measurements and they were compared with values given by the so called shading coefficient method. Few results for comparison of different window structures are given.

4323 (ORO—5299-T1) **Solar heating of a commercial greenhouse. Phase IV final report, 27 May 1977-11 November 1978.** Cummings, G.J. (Western Interstate Energy Board, Denver, CO (USA)). [nd]. Contract EG-77-C-05-5299. 84p. Dep. NTIS, PC A05/MF A01.

Modular Systems Division has constructed what is believed to be the world's largest single solar collector. The collector, a site-built, cavity-type receiver, was assembled on the grounds of S.A. Peterson, Inc., Tewksbury, Massachusetts. It is a demonstration of the technical and economic feasibility of solar heating for a commercial greenhouse. The collector is 150 feet long, 30 feet high, 20 feet wide. Its cross section is that of a right prism with a 55° tilt and a 35 foot hypotenuse. It is capable of collecting 1 million Btu's per hour in its New England location. The module incorporates 10,000 gallons of water storage, which is housed within the collector cavity. The unit is designed to provide partial heating for a 15,000 square foot greenhouse. The University of Massachusetts carried out a plant health monitoring program. They provided the required botanical expertise and advice on the design of the plant/solar system interfaces.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 4400

4324 (CONF-780983—, pp 151-152) **Application of solar energy to continuous belt dehydration.** Sierer, P.D. Jr. (Trident Engineering Associates, Inc., Annapolis, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Trident Engineering Associates, in cooperation with McCormick and Company, Inc. and its subsidiary, Gilroy Foods, Inc., is designing, installing, and evaluating a DOE-sponsored solar industrial process heat demonstration system for application to a food dehydration process. The system will be installed at the Gilroy Foods onion and garlic dehydration plant in Gilroy, California. The collector array provides for 562 m^2 (6048 ft^2) of Owens-Illinois evacuated tube collectors and is estimated to contribute 2.47×10^{12} J/yr (2340 MBtu/yr) to the dehydration process.

4325 (LA-UR—79-2812) **Preliminary definition and characterization of solar industrial process heat technology and manufacturing plant for the year 2000.** Meyer, R.T.; Prythero, T. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-791024—4). Dep. NTIS, PC A02/MF A01.

From Solar industrial process heat conference; San Francisco, CA, USA (31 Oct 1979).

The findings and projections of this preliminary definition and characterization of a solar industrial process heat technology and manufacturing plant for the year 2000 indicate that the technology and the manufacturing would be significantly more sophisticated and expanded than exists in the solar industry today. The solar process heat technology is defined to be a parabolic trough collector system and to utilize a combination of the more advanced materials and components under current development. The manufacturing operations are projected to include glass-making, silvering, electroplating and plastic-forming, which, while standard industrial procedures, will be additions to or expansions of existing solar manufacturing plants. These integrated operations for the year 2000 solar facility will introduce important environmental residuals which will need to be managed and controlled to satisfy local, state, and federal environmental standards. It can be anticipated that the development and growth of the solar manufacturing industry across the nation can produce a shift in both economic activity and environmental impacts to the centers of solar energy utilization.

WATER HEATING

REFER ALSO TO CITATION(S) 4167, 4246, 4260, 4311, 4314, 4440

4326 (CONF-780983—, pp 173-174) **Development of a gas backup heating water tank properly integrated with solar heated domestic water storage tanks.** de Winter, F. (Altas Corp., Santa Clara, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the development of a gas heater which is particularly suited to solar backup service. The result of this effort will be the construction and testing of a prototype (or prototypes) which can then be further developed into production hardware by different manufacturers.

4327 (CONF-780983—, pp 440-444) **Experimental validation of computer programs for solar domestic hot water systems.** Fanney, A.H.; Liu, S.T.; Hill, J.E. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Several computer codes are being widely used to predict the thermal performance of solar domestic hot water (SDHW) systems. However, they have not been sufficiently validated with experimental data to justify their wide use. The primary objective of this project is to conduct controlled experiments on typical state-of-the-art solar domestic water heaters and to determine the extent to which the existing computer programs can accurately predict their performance. A second objective is to investigate alternate methods of testing the systems for the purpose of rating and to support the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) in developing a standard test procedure.

4328 (CONF-780983—, pp 478) **Microprocessor controlled solar collector system.** Wolfson, R.L.T. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4329 Digital simulation of a solar water heating system under natural circulation conditions. Manrique, J.A. (Instituto Tecnologico y de Estudios Superiores de Monterrey, Mexico). pp 783-793 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

One of the most serious problems with the simulation or design of a solar water heating system under natural circulation conditions is the lack of experimental radiation data. This is particularly true in developing countries where solar energy technology is most needed. A mathematical model is presented for the design of a solar water heating system in a location where only the monthly average of total radiation on a horizontal surface is available or may be estimated. The model is therefore a valuable design tool for estimating the most appropiate collector-storage tank geometry. The computer program has been tested with an experimental prototype and the results are very satisfactory.

OTHER

4330 (CONF-780983—, pp 44-45) **Development of solar-operated thermopump.** MacCracken, C.D. (CALMAC Manufacturing Corp., Englewood, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the development effort was to design, build and test a solar-operated pump capable of pumping at a maximum flowrate of 10 GPM, and at a maximum head pressure of 50 feet. Hardware meeting these specifications could be used to pump water from a source such as a well, lake or stream for irrigation or stock-watering purposes, particularly in underdeveloped countries, or to circulate the heat transfer fluid between the collectors and heat storage system in a solar heating or cooling system.

4331 (CONF-780983—, pp 291-295) **Development of a solar desiccant dehumidifier.** Lavan, Z.; Gidaspow, D. (Illinois Inst. of Tech., Chicago, IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A preliminary design for a cross-cooled two ton silica gel dehumidifier is presented. The system consists of two identical fixed bed units. One dehumidifies while the other is being regenerated. Cross-cooling is achieved with air flowing through rectangular channels and the process stream flows in perpendicular channels which are lined with paper-like sheets consisting of micron size silica gel particles held in a Teflon web. These sheets were made by a specially developed manufacturing procedure and were tested in an isothermal channel. A prototype dehumidifier was constructed and is presently being tested. Detailed calculations predict a COP of about 0.50 with 82°C regeneration temperature, a temperature readily attainable with flat plate solar collectors. Due to the low pressure drop in the channels the electric coefficient of performance (EER) is about 25.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 4148, 4192, 4290, 4313, 4440

4332 (CONF-780983—, pp 1-6) **Overview of solar collector research, development and commercialization.** Bankston, C.A. (Los Alamos Scientific Lab., NM); Sargent, S.L. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The National Program for Research and Development in Solar Heating and Cooling, based on the 1976 program plan published as ERDA 76-144, has now been largely implemented. The collector research, development and commercialization program is the largest element of the R & D Program consisting of nearly 100 projects in the development and commercialization of various types of collectors and relevant studies or research in collector technology and materials. The objectives, scope, emphasis, structure, and status of the collector program are described. The projects that comprise the program are listed in five categories and the relationships between the projects in each category and the needs and goals of the applications paths of the R & D Program are discussed. The collector development projects are individually described and recent accomplishments are cited in separate papers dealing with liquid-heating, air-heating and concentrating collectors, collector studies, and materials research and development.

4333 (CONF-780983—, pp 7-8) **Overview of non-concentrating air-heating collectors.** Sibbitt, W.L. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objectives of these efforts were to reduce the cost of components and system procurement and operation and to simultaneously improve the reliability and performance. Therefore, most of the contractors endeavored to develop a low-cost solar collector; measure the performance and then predict: potential applications, system requirements, longevity, life-cycle costs, etc.

4334 (CONF-780983—, pp 9-13) **Overview of nonconcentrating liquid heaters.** Neeper, D.A. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Development in nonconcentrating liquid heaters can be arbitrarily divided into attempts at improving performance, improving operation, reducing cost, or investigation of novel systems. Plastic collectors promise to be very inexpensive, but have unproven durability. Solar ponds should combine large collection area with seasonal heat storage, but unlike flat plates, pond operation is not fully understood. The program is reaching maturity where increasing coordination among researchers and more publication of results are necessary.

4335 (CONF-780983—, pp 14-15) **Overview of concentrating collectors.** Collier, R.K. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This paper highlights the projects funded by the R & D Branch for Solar Heating and Cooling of the DOE in the area of concentrating collectors. Past and present projects are described along with their expected accomplishments. Significant accomplishments to date are described and listed. These accomplishments cover areas from meeting expected cost goals to experimentally verifying concepts and performance predictions.

4336 (CONF-780983—, pp 16-18) **Overview of collector studies.** Grimmer, D.P. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Collector studies can be defined as basic studies and applied research projects conducted in a variety of areas of importance to the development and commercialization of solar collectors of all types. This paper presents an overview of collector studies funded by the R & D Branch for Solar Heating and Cooling of the DOE.

4337 (CONF-780983—, pp 19-20) **Collector materials R & D overview.** Moore, S.W. (Los Alamos Scientific Lab., NM). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Materials research and development is essential to the commercialization of solar collectors. Material selection for all collector components must be evaluated with respect to operating parameters, performance, durability, and above all, life-cycle costing. In many cases new materials must be developed or modified to suit the specific needs of solar collector applications.

4338 (CONF-780983—, pp 21-24) **Low-cost solar panel development program.** Nelson, E.V. (Acurex Corp., Mountain View, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The Low-Cost Solar Panel (LCSP) concept is based on the use of polymer films which are combined in high-speed printing, laminating and extruding processes to make a flexible absorber structure. Good strength characteristics and resistance to environmental degradation are obtained by selection of the proper combination of materials. The outermost layers of the laminated structure are polyester (PET), which has very good strength and abrasion resistance. The uppermost PET layer is black and uv-stabilized to provide absorption of incident solar energy and long-term protection of the structure from ultraviolet degradation. The inner layers of the absorber are Hytrel, a DuPont polyester elastomer. Some technical accomplishments are outlined.

4339 (CONF-780983—, pp 25) **Development of cost effective techniques and concepts for the protection of glazing against breakage caused by hail, vandals, and thermal stresses.** de Winter, F. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the determination of the most cost effective way to prevent or minimize the problems associated with glazing breakage which may be caused by hail, vandalism or thermal stresses. For frequent occurrences and low momentum impacts (small hailstones or vandal-projectiles) it may be most desirable to build in devices which will prevent breakage. With large or infrequent impacts, breakage prevention may be impractical and insurance schemes may be more cost effective.

4340 (CONF-780983—, pp 26-27) **Development of a second-generation concentrating tracking solar collector.** Miller, R.W. (American Science & Engineering, Inc., Cambridge, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project is to develop a second-generation concentrating tracking solar collector with emphasis on improving performance and reducing production unit costs. The approach combines a parabolic mirror concentrator with a variation of the cylindrical blackbody receiver to provide a concentration ratio of ten. Performance characteristics are to be determined by tests using a prototype unit.

4341 (CONF-780983—, pp 28-31) **Development of compound parabolic concentrators for solar heating and cooling applications.** Reed, K.; Schertz, W.W. (Argonne National Lab., IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the development and commercialization of improved collector systems for solar heating and cooling applications. The improvements sought include higher operating temperatures, increased efficiency, lighter weight, and lower cost. The project builds on present day technology, developing those areas necessary for reaching the objective. The project combines basic collector and system design studies with fabrication and testing of engineering prototypes of the most promising designs. To promote early commercialization, intensive industrial interaction is

encouraged through component development subcontracts, an industrial participant program, and a strong commitment to provide technical support to potential designers and manufacturers.

4342 (CONF-780983—, pp 32-33) **Corrosion problems with aqueous coolants.** Diegle, R.B. (Battelle's Columbus Labs., OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The ultimate objective of this project is to provide a data base with which to achieve cost effective solar collectors through control of corrosion. This will be accomplished by acquiring information, both through experiment and the published literature, relative to the corrosion performance of metallic solar collector materials in candidate collector heat transfer media.

4343 (CONF-780983—, pp 39) **Commercial selective surfaces applicable to copper, aluminum and stainless steel: their cost effective improvement and evaluation of potential durability in solar absorbers.** Cotsworth, J.L. (Berry Solar Products, Edison, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4344 (CONF-780983—, pp 40-43) **Transpired solar air heaters.** Buchberg, H.; Edwards, D.K. (Univ. of California, Los Angeles). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objective of this investigation is to establish and prove the technical merit of two transpired solar air heater concepts: a honeycomb, porous bed absorber and a slotted flat or vee-corrugated plate absorber. Technical and cost data are being developed to determine the most meritorious designs for commercial use.

4345 (CONF-780983—, pp 46-47) **Development of the SunMat non-metallic solar collector.** MacCracken, C.D. (CALMAC Manufacturing Corp., Englewood, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the development effort was to design, build and test liquid, flat plate collector systems using a flexible, non-metallic absorber plate. This type of absorber offers a number of potential advantages, including lighter weight, resistance to corrosion, lower cost, freeze tolerance, and more flexibility in sizing to meet installation requirements.

4346 (CONF-780983—, pp 48-49) **3X CPC solar collector.** Ballheim, R.W. (Chamberlain Manufacturing Corp., Waterloo, IA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The main objective of this project is to develop a 3X concentrating, high temperature, non-tracking solar energy collector. A truncated version of the Compound Parabolic Concentrator Reflector and the General Electric Evacuated Tubular Receiver will be combined into a mass producible collector design for use at 300 to 450°F. The key criteria for optimization of the design will be minimization of the cost per Btu collected. Prototypes will be built and performance verification testing will be accomplished.

4347 (CONF-780983—, pp 50) **Solar selective absorber coatings by the electrodeposition of paint.** Wolf, R.E. (DeSoto, Inc., Des Plains, IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This effort is directed at the development of solar selective absorber coatings through the electrodeposition of paints onto metal absorber panels. This process has the potential for depositing uniform coatings in the film thickness range desired for solar selective properties. The process and material parameters of various electrocoating systems will be studied to obtain the maximum solar absorptance while minimizing thermal emittance of the coatings.

4348 (CONF-780983—, pp 51-54) **Optimized concentrating/passive tracking solar collector.** Sterne, K.E. (Direct Energy Corp., Irvine, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project is to develop an optimized concentrating/passive tracking solar collector, build and test three prototypes, and report the results. Optimization is achieved first in the optical design of the reflector surface, and then in the method of construction so that the total effective cost per unit of energy obtained at a given temperature is minimized.

4349 (CONF-780983—, pp 56-57) **Double-exposure collector system.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this project were (1) to evaluate the performance of two previously constructed double-exposure collectors, (2) to study alternative mirror enclosure designs for various solar energy applications and for various latitudes, and (3) to perform a detailed design and cost analysis for a determination of cost-effectiveness of the concept.

4350 (CONF-780983—, pp 58-61) **Non-concentrating collectors for solar heating and cooling medium temperature air heater.** Hanson, K.L. (General Electric Co., Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The overall objective of this project is to develop a superior Btu/$ solar heater for space heating and domestic hot water applications. The end result is to be a non-concentrating medium temperature air heater that can be adopted to both applications. It is intended to design the system to meet requirements identified in a non-contract funded market analysis for modest i.e., residential heating demands. It is intended to utilize the vacuum tube solar absorber previously developed by General Electric for solar collectors. Cost effectiveness and producibility for volume are key considerations.

4351 (CONF-780983—, pp 62-66) **Study of corrosion and its control in aluminium solar collectors.** Giner, J. (Giner, Inc., Waltham, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The main objective of this program is to determine the requisite conditions under which aluminum solar thermal energy collector systems operating on water/glycol heat transfer fluid can be safely used for a reasonable period of time without encountering catastrophic corrosion problems. An intermediate objective is to ascertain the extent of the corrosion problem under various conditions directly relevant to the operation of existing solar heat collector systems.

4352 (CONF-780983—, pp 67-68) **Selective IR reflective coatings.** Lefkow, A.R. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this program is the development of a cost effective method of coating thin plastic foils with a solar transparent, infrared reflective coating, i.e., a heat mirror. The optical properties goals are 85% to 90% solar transmission and 90% to 95% infrared reflectance at the peak of the room temperature black body spectrum. Coated plastic substrates with these optical properties can be used to enhance the performance of solar collecting systems and to reduce heat loss through building windows.

4353 (CONF-780983—, pp 69) **Selective paint and black chrome coatings development.** Lin, R.J.H.; Zimmer, P.B. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purpose of this program is to improve the performance of solar selective black chrome and paint coatings. Extensive study of the solution chemistry of black chrome process and various undercoat/substrate combinations will lead to improved coating durability and optical properties, improved control and reproducibility of the fabrication process, and reduced coating costs. Improving adhesion and abrasion resistance will be the major concern in the paint coating efforts, as will the development of techniques for large scale application.

4354 (CONF-780983—, pp 70) **Low-cost solar antireflection coatings.** Lin, R.J.H. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the program is to develop and improve large-scale production processes for low-cost etched antireflection (AR) coating and organic AR coating on glass.

4355 (CONF-780983—, pp 71-72) **Low-cost solar air heater.** Rask, D.R. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The program objective was to design, fabricate, test and evaluate a unique jet impingement concept air collector. The intention was to increase the efficiency of the air heater, over that of a conventional parallel plate type, by increasing the absorber plate-to-air stream heat transfer coefficent via the jet impingement concept.

4356 (CONF-780983—, pp 73) **Survey mirrors and lenses and their required surface accuracy.** Smith, G.A. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This study will investigate and evaluate the potential performance of solar concentrators using plane or cylindrical mirror and lens surfaces of various types. This study will include the full spectrum of

configurations from simple V-troughs to units with concentration ratios of 10 or more. The evaluation will include real surface effects such as manufacturing irregularities, surface properties, aging of surfaces and deformation of surfaces due to applied loads or thermal stresses. Effects of glazing on initial performance and upon aging of the collector will also be considered. The effect of dirt and other environmental accumulations on the reflective surface or lenses of the concentrating collectors will be evaluated. Requirements for maintaining the optical quality for concentrators will also be investigated.

4357 (CONF-780983—, pp 74-75) **Dual curvature acoustically damped concentrating collector.** Smith, G.A. (Honeywell, Inc., Minneapolis, MN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project represents the initial development phase for the Dual Curvature Acoustically Damped Concentrating Collector concept. The project's first objective is to establish, analytically, the cost and performance of design choices within the boundaries of the basic proposed concept. With these cost and performance measures as a guide, the second project objective is to design a cost-effective Dual Curvature collector module and collector field array. The third objective is to establish technical and economic concept feasibility through prototype fabrication and test. The final objective is to define the Dual Curvature collector commercialization requirements.

4358 (CONF-780983—, pp 76-77) **Analysis, design, fabrication, and testing of moderately concentrating solar energy collectors.** Bannerot, R.B.; Howell, J.R. (Univ. of Houston, TX). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The overall objective is to develop low-cost moderately high temperature, efficient solar energy collectors utilizing non-tracking concentration in east-west aligned groove-like geometries. The concentration is achieved with reflective side walls which redirect the insolation onto a receiver located at or near the bottom of the groove.

4359 (CONF-780983—, pp 78-79) **Exposure testing and evaluation of solar collector materials.** Gilligan, J.E. (ILlinois Inst. of Tech., Chicago). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this project have been and are to (1) establish comprehensive, objective criteria for the testing and evaluation of potential Solar Utilization (SU) Materials; (2) determine relevant properties data of SU materials appropriate for the selection of cost-effective materials; and (3) predict long-term weathering performance.

4360 (CONF-780983—, pp 80-81) **Solar collector studies for solar heating and cooling applications.** Liers, H.S. (Intertechnology/ Solar Corp., Warrenton, VA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A survey of mirror and lens solar concentrator collectors suitable for space heating, cooling, and hot water applications will be conducted during this project. The two objectives of the survey are to provide DOE with detailed comparative design, performance, and delivered energy cost data which can be directly utilized in their R & D planning, and to provide the user community with this information presented in an understandable format so that the relative merits of each collector can be evaluated.

4361 (CONF-780983—, pp 82-83) **Fixed tilt solar collector with reversible Vee-trough reflectors and evacuated tube receivers.** Selcuk, M.K. (Jet Propulsion Lab., Pasadena, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the Vee Trough/Evacuated Tube Collector (VTETC) Project was to demonstrate the usefulness of the Vee-Trough Concentrators in improving the efficiency and reducing the cost of solar collectors consisting of evacuated tube receivers. The Vee-trough concentrators allow for a low operating cost, minimal maintenance, reliable performance, and a relatively low initial cost.

4362 (CONF-780983—, pp 86-87) **Inflated cylindrical concentrator.** Gerich, J.W. (Lawrence Livermore Lab., CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this contract is to determine the technical feasibility of an inflated cylindrical concentrator for producing industrial process heat. To show technical feasibility we determined it was necessary to model the optical and heat transfer performance of the collector and then to verify the accuracy of our model with data from an experimental collector.

4363 (CONF-780983—, pp 88-89) **Development, fabrication, and delivery of the Solar II Collector.** Murrish, C.M. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objective of the Solar II Collector was to develop an optimal solar hot air, flat plate collector that would meet Subsystems Performance Specifications and applicable parts of the Interim Performance Criteria. Secondary objectives were to determine the optimum plenum spacing, absorber efficiency, optimum flow rates, absorber coating durability, optimal glazings and the capability to survive worst case conditions.

4364 (CONF-780983—, pp 90-91) **Low cost high temperature cement bonded collector.** Dame, R.E. (Mega Engineering, Silver Spring, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to design and construct a low-cost, high-temperature, liquid heating flat-plate collector using low cost materials bonded to copper circulating tubes by high-service temperatures, low outgassing, high conductivity adhesives.

4365 (CONF-780983—, pp 92) **Addition of solar air-heaters to pre-engineered metal buildings.** Forbes, R.E. (Mississippi State Univ., Mississippi State). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this work is to develop and test an inexpensive solar air-heater which is added to a pre-engineered metal building. The collector concept utilizes the metal skin of the building as the collector absorber plate.

4366 (CONF-780983—, pp 93-94) **Medium temperature air heaters based on durable transparent films.** Ball, G.L. III; Leffingwell, J.W. (Monsanto Research Corp., Dayton, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this contract was to make available a low-cost durable medium temperature solar air heater. In accomplishing this objective, low-cost, specially stabilized and reinforced polyvinylchloride (PVC) film was to be optimized and used.

4367 (CONF-780983—, pp 95-96) **Low-cost mirror concentrators, based on double-walled, metallized, tubular films.** Ball, G.L. III; Schwendeman, J.L.; Leffingwell, J.W. (Monsanto Research Corp., Dayton, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purpose of this work is to develop an innovative non-tracking mirror concentrator of about 3X concentration ratio. There is to be an emphasis placed upon improving the methods by which the design may be optimized to reduce the cost of mass produced units and an emphasis on the required manufacturing tolerances for the shape and placement of the mirrors. It is expected that the concentrators will eventually be integrated with high performance receivers to produce temperatures slightly lower than those produced by the 10X concentrators.

4368 (CONF-780983—, pp 97) **Superior liquid coolants for solar heating and cooling applications.** Parts, L. (Monsanto Research Corp., Dayton, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A program was undertaken to evaluate commercially available, developmental, and candidate fluids for solar heating and cooling applications in order to determine the fluids of superior performance characteristics that are also cost-effective.

4369 (CONF-780983—, pp 98-99) **Evaluation of the Miamisburg salt-gradient, solar pond.** Wittenberg, L.J. (Mound Facility, Miamisburg, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project is directed toward data collection and evaluation of the performance of the largest working, salt-gradient, solar pond in the world.

4370 (CONF-780983—, pp 100-103) **Development of standard methods for testing solar collectors and thermal storage devices.** Hill, J.E.; Jenkins, J.P.; Jones, D.E.; Streed, E.R. (National Bureau of Standards, Washington, DC). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to develop standard testing procedures that can be used for rating solar collectors and thermal storage devices that are used in systems for heating, cooling, and heating of hot water in buildings.

4371 (CONF-780983—, pp 104-105) **Demonstration salt-gradient solar pond.** Bryant, H.C. (Univ. of New Mexico, Albuquerque). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The principal objective is to investigate and illustrate the potential usefulness of salt gradient solar ponds in the Southwest as economical sources of hot water. The physics of the solar pond is studied in order to understand the source and corrections for instabilities as well as the relative importance and optimum values of the various parameters that affect the pond's performance. A computerized model of the pond is being prepared to be used in determining scaling laws and optimum dimensions for given heat production schedules, ground, weather and insolation conditions.

4372 (CONF-780983—, pp 106-107) **Evaluation of heat transfer enhancement in air-heating collectors.** Youngblood, W.W.; Mattox, D.L. (Northrop Services, Inc., Huntsville, AL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Data correlations and theoretical analysis techniques of general applicability are being developed for air heating solar collector absorbers. The results of this contract effort are designed to provide the tools and methodologies that will allow air heating solar collector absorbers of diverse design to be evaluated on a comparative basis. The study will concentrate on those techniques which show promise of increasing the convection heat transfer coefficient between the air and the collector absorber plate, while minimizing the pressure loss and the construction cost.

4373 (CONF-780983—, pp 108) **Development of a second generation concentrating collector.** Waller, R. (Northrup, Inc., Hutchins, TX). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The goal of the project was to design, fabricate, and test an improved linear fresnel lens concentrating collector. The performance, reliability, and overall marketability of the original Northrup collector were to be enhanced.

4374 (CONF-780983—, pp 109-113) **Salt-gradient solar pond development.** Nielsen, C.E. (Ohio State Univ. Research Foundation, Columbus). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objectives of this project are to construct a solar pond that will permit an accurate measurement of energy balance, and to simulate the observed performance of this pond with a computer model. There is at present no useful energy balance data on any solar pond, and only limited information on heat output and temperature attainable. Given agreement between the model and observations in this one case, it will be possible to predict with more confidence the performance to be expected of other ponds in other environments. A further objective of the project is to develop pond management procedures that will insure the continuing reliable pond operation essential to practical application. Prominent among questions requiring study is the behavior of the boundary between convective and non-convective regions in the pond.

4375 (CONF-780983—, pp 114-115) **Development and delivery of 334 sq ft of prototype air cooled collector.** Moan, K.L. (Owens-Illinois, Inc., Toledo, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The principal objective of the project was to demonstrate that non-concentrating air heating collectors can provide high performance high efficiency thermal operation comparable to that available from liquid heating systems. Further objectives were to provide physical evidence of the safety and reliability, physical ruggedness, low weight, ease of installation and maintenance and essentially idiot proof characteristics that can be obtained with a low loss coefficient air cooled collector subsystem.

4376 (CONF-780983—, pp 116-117) **Draining of the SUNPAK/sup TM/ evacuated tube collector.** Pei, Y.K. (Owens-Illinois, Inc., Toledo, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project was to develop a manifolding configuration such that a SUNPAK/sup TM/ evacuated tube collector array can be drained of liquid.

4377 (CONF-780983—, pp 118-119) **Evaluation of solar selective coating stability.** Spanoudis, L. (Owens-Illinois, Inc., Toledo, OH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to increase the cost effectiveness of evacuated tubular collectors by (1) increasing the high temperature resistance of the selective coating, and (2) increasing the absorptivity of the selective coating through the use of antireflective coatings.

4378 (CONF-780983—, pp 120-121) **Air heating structural blocks.** Payne, P.R. (Payne, Inc., Annapolis, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Concrete is a low cost material in terms of both dollar cost and the fossil fuel energy investment required to produce it. So as a way of reducing the energy and dollar first cost of solar heating, we are attempting to develop concrete solar collectors. A further cost reduction may be possible if these collectors are designed to replace conventional structural block in south-facing walls. Preliminary test data has given encouraging results for air heating blocks, and the remaining objectives are to refine these designs, certify the block structurally, and bring it to the marketplace.

4379 (CONF-780983—, pp 122) **Black germanium selective absorber surfaces.** Vedam, K.; Messier, R.F. (Pennsylvania State Univ., University Park). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

A description is given of a program to develop the basic and applied understanding of sputtered film preparation and characterization and resulting selective solar absorbing properties of Black Ge films.

4380 (CONF-780983—, pp 123) **Forced and natural convection studies on solar collectors for heating and cooling applications .** Pearson, J.T. (Purdue Univ., West Lafayette, IN). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4381 (CONF-780983—, pp 124) **High temperature evacuated collectors.** Crouthamel, M.S. (RCA Corp., Camden, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this current program is to develop an evacuated tubular collector using amorphous silicon as a heat absorbing film. Other techniques to be explored are: (1) solar antireflection surfaces; (2) infrared reflective surfaces; and (3) selective absorbers. When a-Si has matured as a photovoltaic converter, an objective of a future program will be to build a cost effective dual function collector (heat and electricity).

4382 (CONF-780983—, pp 127-128) **Image collapsing concentrators.** Sletten, C.J. (Solar Energy Tech., Inc., Bedford, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project was to design a non-tracking Stepped Lens Solar Concentrator with a special Image Collapsing Subreflector to literally make the sun stand still over most of the sun's annual path. Given this very large acceptance angle requirement, the objective is to use the refractive power of a wide-angle lens with the compound optics of a lens and subreflector to construct a high concentration ratio, high aperature efficiency solar collector with low cost per unit area techniques.

4383 (CONF-780983—, pp 129-130) **Development of polyimide materials for use in solar energy systems.** Gagliani, J. (Solar International Harvester Group, San Diego, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this program is that of characterizing and optimizing flame resistant no-smoke emitting open-cell polyimide foams possessing improved insulation characteristics, resistance to outgassing, moisture retention, thermal and dimensional stability, and cost effectiveness for application in solar collectors and other solar system components.

4384 (CONF-780983—, pp 131-134) **Improvement of solar air collectors: study and experimental research project.** Cole-Appel, B.E.; Lof, G.O.G.; Shaw, L.E.; Fischer, B.B. (Solaron Corp., Denver, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project was to examine cost effective improvements to the heat transfer characteristics of a baseline air heating collector. For the sake of comparison, its characteristics regarding dual glazing, nonselective absorber coating, pressure drop and back/edge losses were retained.

4385 (CONF-780983—, pp 135) **Non-concentrating collectors for solar heating and cooling applications.** Newton, R.A. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to produce a flat plate collector which has excellent performance over all usual temperature

levels and insolation values, and yet has a lower cost and lighter weight than most contemporary designs.

4386 (CONF-780983—, pp 136-137) **Non-glass glazings & surface coatings.** Baum, B. (Springborn Labs., Enfield, CT). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The goal of this program is to survey and evaluate polymeric and other non-glass materials for collector glazing and housing and uv protective coatings for plastic glazing. Such materials must be weather (uv) and heat resistant (up to 300°F). Also to be studied are surface etching processes for reducing reflectivity of plastics and ir and/or anti-reflective coatings to increase solar transmittance of non-glass glazing while retaining reflection characteristics. Means for applying ir- and/or anti-reflective coatings uniformly in large-volume production will be investigated. Cost studies will be made of collector glazing and housing materials as well as the comparative cost effectiveness of surface etching versus anti-reflective coatings and of uv protective coatings versus compounding the stabilizer into the polymer molecule.

4387 (CONF-780983—, pp 138) **Development of a 10X lens concentrator.** Holdridge, D. (Swedlow, Inc., Garden Grove, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Swedlow, Inc. will develop design application data and demonstrate a low concentration (10X) linear Fresnel lens suitable for but not limited to solar heating and cooling applications. This program will inlude performance predictions for candidate designs. A procedure will be developed to aid designers in Fresnel lens selection.

4388 (CONF-780983—, pp 139-140) **Development of selective surfaces.** Thornton, J.A. (Telic Corp., Santa Monica, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the program is to develop methods for producing low cost selective absorber surfaces by dc reactive sputtering using magnetron type sources. Two representative absorber coatings will be developed as a vehicle for evaluating the sputtering technology. These are a sputter-deposited metal oxide of the black chrome type and a multilayer Al_2O_3-Mo-Al_2O_3 coating for concentrating collectors. In two proof-of-concept phases metal oxide coatings will be continuously deposited on aluminum foil, and hollow cathodes will be used to deposit Al_2O_3-Mo-Al_2O_3 coatings over short tubular sections.

4389 (CONF-780983—, pp 142-145) **Structural integrity of solar collectors.** Chevalier, H.L. (Texas A & M Univ., College Station). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this study are to develop more accurate load predicting techniques for solar collector structures and to determine whether supporting structures and collector structures can be materially reduced with a resultant cost savings.

4390 (CONF-780983—, pp 146-148) **Cost effective solar collectors using heat pipes.** Ernst, D.M. (Thermacore, Inc., Leola, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The program objective is the demonstration of high performance, cost effective, non-concentrating solar collectors using heat pipes. The end product will be directly applicable for efficient use with absorption and Rankine cycle chillers.

4391 (CONF-780983—, pp 149-150) **Development of a site-fabricated building integrated air collector.** Kohler, J.T. (Total Environmental Action, Inc., Harrisville, NH). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The general goal of this project is the development of a cost-effective, durable, site-fabricated flat plate solar air heater. The specific objectives of the study are: (1) development of a site-fabricated solar air heater design with performance comparable or superior to presently manufactured collectors; (2) development of the air heater design so that it can be cost-effectively integrated into building structures in the majority of potential building situations with a minimum of construction problems; and (3) development of sufficient technical and economic data, drawings, and other information to promote the application of the design and provide for its evaluation.

4392 (CONF-780983—, pp 153-154) **Studies for predictably modifying the optical constants of doped indium oxide films for solar energy applications.** Goldner, R.B. (Tufts Univ., Medford, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this research are to correlate the wavelength dependence (ca. 300 nm-10 μm) of the optical constants of polycrystalline films of doped indium oxide (DIO) with structure, composition, and thermal history and to arrive at a useful model of the electromagnetic behavior of doped indium oxide so that one could predictably modify its optical constants and those of related metal oxides.

4393 (CONF-780983—, pp 155) **Heat transfer through partial vacuum.** Thomas, J.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The project objectives are to review the theoretical heat transfer mechanisms in evacuated solar collectors and to develop a theoretical analysis of gaseous conduction at rarefied pressures. The effect of helium diffusion into the evacuated region is to be assessed, and the minimum partial vacuum necessary to eliminate significant conduction is to be estimated.

4394 (CONF-780983—, pp 156-158) **Methods for reducing heat losses in flat plate solar collectors: phase 3.** Hollands, K.G.T. (Univ. of Waterloo, Ontario). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objective is to produce an algorithm which accurately predicts the combined conductive and radiative heat transfer across the honeycomb in a honeycomb solar collector, when the convective heat transfer is suppressed. Of particular importance is the predictive capability of the method when the lower bounding surface is of low emissivity, this representing the case where the honeycomb has been combined with a selective surface on the absorber plate. When such a predictive method is available, the desirability and technical soundness for combining a honeycomb and a selective surface into one flat plate collector can be ascertained. A secondary objective is to evaluate the effect of the absorber plate emissivity on the convection suppression capability of the honeycomb.

4395 (CONF-780983—, pp 159-160) **Grooved Foamglas solar air heater.** Loth, J.L. (West Virginia Univ., Morgantown, WV). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

At West Virginia University, the solar collector research, funded by ERDA, has three major objectives. The first task is to make a cost effective comparison between several configurations employing insulator-like grooved Foamglas as an absorber in solar air heaters. The blackened grooved Foamglas functions simultaneously as a high absorptivity solar absorber, a large rough heat transfer surface and also functions as an insulator. Six differently constructed grooved Foamglas solar air heaters, with a total area of 320 square feet, are mounted on the roof of the Engineering Sciences Building. The second task is to carry out thermal performance tests as outlined in ASHRAE 93-77 for each of the six collectors. The third task is to determine if the solar air heater is more cost effective when it is used during the summer months to preheat domestic hot water.

4396 (CONF-780983—, pp 161-162) **Solar parabolic trough forming process.** Williams, O.G.; Skaggs, R.L. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project was to continue the development of a new process for producing accurate, low-cost parabolic troughs for use in linear solar concentrators and to evaluate the optical accuracy of concentrators produced by this method.

4397 (CONF-780983—, pp 163-164) **Interferometric study of the natural convection characteristics.** El-Wakil, M.M.; Mitchell, J.W. (Univ. of Wisconsin, Madison). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of the project are to obtain basic natural convection heat transfer data applicable to flat plate solar collectors. The geometries studied correspond to the spaces between absorber and cover plates. Data is obtained for geometries representative of flat plate, vee-corrugated, and slat collectors. The influence of tilt angle and spacing (aspect ratio) has been evaluated. A supporting analytical study of the governing differential equations has been carried out. Correlations are developed for each geometry that cover range of interest to designers of collectors.

4398 (CONF-780983—, pp 165-166) **Polymer surface coatings for downconversion of uv radiation and inhibition of photodegradation.** Yen, W.M.; Yu, H. (Univ. of Wisconsin, Madison). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this work is to develop and evaluate the surface coatings on polymeric substrates which will down-convert the uv component of solar radiation into the visible or ir region and will simultaneously inhibit photodegradation of the plastic glazings.

4399 (SAND—78-8190) **Non-inverting heliostat study.** Blackmon, J.B. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 101p. Dep. NTIS, PC A06/MF A01.

Implications of employing a non-inverting heliostat design with a lower capital cost relative to an inverting design are considered from three standpoints: (1) effects of dust buildup, corresponding cleaning frequencies, and resultant cleaning costs; (2) effects of hail impact; and (3) refleccted beam safety issues. It is concluded that elimination of the inverting stow hardware and addition of reflector area in the slot required for inverting the reflector provides a direct subsystem cost savings. Since the non-inverting heliostat must be stowed face-up during high winds, reflectance degradation rates due to dust buildup are increased. The economic optimum cleaning frequency and allowed loss of reflectance due to dust buildup are determined so as to minimize the total system cost, and it is found that an overall cost savings of 12-13 percent results if the inverting capability is eliminated. Hail impact damage and probability of occurrence for the United States are determined within the accuracy of available data. Analysis indicates that the commercial heliostat laminate glass design considered will survive 1 1/2 inch hailstones and is suitable for installation over most of the US with low to negligible risk from hail damage. Reflected beam safety hazards are analyzed for the non-inverting design relative to the inverting design. No compelling reason is found to require an inverting stow capability, and therefore, a non-inverting stow heliostat is concluded to be a viable, cost-effective option.

4400 (UCRL—82367) **Application of shallow solar ponds for industrial process heat: case histories.** Casamajor, A.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 May 1979. Contract W-7405-ENG-48. 13p. (CONF-790541—57). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The shallow-solar-pond collector system developed by the Lawrence Livermore Laboratory is approaching commercialization. Three prototype or demonstration projects, Sohio Petroleum Company, Sweet Sue Kitchens, and Fort Benning, are described. A critique of each project points out the significant factors that affect the individual projects and shallow-solar pond technology in general. Particular attention is drawn to problems encountered and solutions proposed. Finally, possible marketing organization and strategies are discussed.

4401 **Coated metal nodule solar heat collector.** Albertson, C.E. (to Borg-Warner Corporation). US Patent 4,171,993. 23 Oct 1979. Filed date 6 Mar 1978. 4p.

A solar heat collector is disclosed comprising a metallic substrate having nodular or dendritic surfaces coated with a black absorber coating, and the method of preparing same.

4402 **Image collapsing concentrator and method for collecting and utilizing solar energy.** Sletten, C.J. (to Solar Energy Technology, Inc.). US Patent 4,171,695. 23 Oct 1979. Filed date 3 Oct 1977. 10p.

A solar energy concentrator comprising a cylindrical Fresnel lens, a specially shaped and positioned reflecting mirror, and a shaped tubular receptor for conveying the collected energy to terminals is described. These concentrators are arrayed parallel and contiguous to each other and oriented generally along an East-West line to receive the sun's radiant energy, and the lenses together with the special reflectors and designed to accommodate large elevation angle variations of the sun. The large acceptance angles achieved with the image collapsing concentrator, while at the same time maintaining a high concentration ratio, improve the reception of diffused as well as direct sunlight and the small surface area of receiving tubes diminishes the thermal radiation losses. A method for determining the shape and location of the special image collapsing reflector is described and applied to solar concentrators employing both lenses and reflectors of cylindrical and three dimensional forms.

4403 **Solar heater.** Sadler, C. US Patent 4,170,983. 16 Oct 1979. Filed date 30 Jun 1978. 8p.

A novel solar collector is disclosed and described comprising a base and a plurality of upstanding walls extending about the perimeter of the base. An input and an output extend through the walls to communicate with a plurality of liquid conduits integral with the base. A transparent cover is secured to the upstanding walls for covering the base and the plurality of conduits. The conduits and the base with the upstanding walls are constructed of a one-piece molding of a curable material.

4404 **Solar energy heat collector.** Scheffee, R.S. (to Atlantic Research Corporation). US Patent 4,170,984. 16 Oct 1979. Filed date 17 Feb 1977. 12p.

A gravity-flow, sheet-flow solar heat collector is disclosed wherein the heat-absorbent medium is a dark fluid having a minimum viscosity of about 10 centipoise at 120°F.

4405 **Solar energy collector.** Authier, B.F. (to Agence Nationale de Valorisation de la Recherche (ANVAR)). US Patent 4,170,985. 16 Oct 1979. Priority date 20 Sep 1976, France, 10p.

The invention relates to a solar energy collector or cell comprising a fixed spherical mirror placed on the ground by its convex face and a boiler in which circulates a heat-transfer fluid and which is movable about the center of the mirror. The boiler comprises a low concentration boiler surmounted by a high concentration boiler. The spherical mirror has a visor in the form of a spherical sector which moves on the periphery of the mirror.

4406 **Four quadrant, two dimensional, linear solar concentration panels.** Kelly, D.A. US Patent 4,168,696. 25 Sep 1979. Filed date 30 Sep 1976. 10p.

The four quadrant, deep concave, linear solar concentration panel has been evolved to meet the need for a practical, low-cost solar energy conversion system, for individual house power supplementation installations. This specific type of solar concentration panel is not designed for a solar photovoltaic conversion arrangement, but for a water steam and flash boiler pipe arrangement where the generated steam is used to drive a rotary steam engine and 110 VAC alternator with a minimum rating of 10 kW/hr. The advocated solar concentration panel has a panel width to flash boiler pipe diameter of about 18:1, which provides a solar concentration ratio of between 22:1 and 27:1, at this point in time. The concentration panel width to height cross-section ratio is approximately 2.5:1, and the base focal line distance to panel height ratio is 1:2.5.

4407 **Static solar tracker and energy converter.** Hackworth, A.J. US Patent 4,167,936. 18 Sep 1979. Filed date 8 Aug 1977. 4p.

A fluid-containing tube is supported by a radially-disposed, heat absorbing fin so as to be coaxial with the reflective inner surface of a hemi-cylindrical reflector. Such a combination, if positioned with the reflector aperture substantially horizontal and with a North-South disposition of the reflector axis, or with the reflector aperture vertical, its axis substantially vertical and with a Southern exposure of that aperture, will produce effective sun-tracking and efficient heating of the fluid in the tube throughout the daylight hours even though the reflector remains static.

4408 **Low cost solar collector.** McGraw, T.F. US Patent 4,166,445. 4 Sep 1979. Filed date 30 Dec 1977. 6p.

A solar collector is disclosed having a frame-like wooden housing which contains therein heat absorbing material in the form of pellets of coal or diced automobile tires. This material is sealed within the housing by a transparent cover. The resultant sealed container allows a flow of working fluid to pass therethrough by way of a pair of perforated pipes. The collector is oriented to receive maximum solar radiation in order to heat the heat absorbing material. The working fluid, which flows in contact with the heat absorbing material, absorbs heat therefrom, and, by means of a circulating system which is not part of the invention is generally carried to a storage tank or the like for use at a later time.

4409 **Concentrating solar receiver.** Dorfeld, W.G.; Ortabasi, U. (to Corning Glass Works). US Patent 4,166,917. 4 Sep 1979. Filed date 22 May 1978. 8p.

There has been provided a concentrating solar receiver of the type including a closed envelope having a window and reflective portions. A photocell is disposed at a focal zone for the reflector. Heat and/or electricity may be produced from received solar energy and the envelope is manufactured in the configuration of a specially formed bulb preferably having a thin wall glass structure. 17 claims.

4410 **Solar energy collector and installation employing same.** Miquel, J.F. (to Agence Nationale de Valorisation de la Recherche). US Patent 4,159,707. 3 Jul 1979. Priority date 26 May 1976, France, 12p.

The invention relates to a solar energy collector of the type comprising a pick-up receiving the solar radiation and converting at least a part of this radiation into heat, and heat-exchange means bringing a heat-exchange fluid into thermal contact with the pick-up and evacuating this fluid towards a user station, said pick-up comprising an assembly of juxtaposed plates which are substantially parallel to one another and form a layer, wherein the distance between two adjacent plates is chosen so as to constitute a well of heat in which the solar radiation is subjected to at least two reflections, at least one of the opposite faces of this well of heat is selectively absorbent for the infrared part of the solar radiation, the two faces of this well are substantially reflecting for the rest of the solar spectrum, and the layer of plates is disposed between a front transparent wall receiving the solar radiation and a rear wall, these

walls being substantially parallel to said layer and defining therebetween an enclosure in which a heat-exchange fluid circulates. The invention also concerns an installation employing this collector.

4411 Solar energy pick-up. Madern, J.P. US Patent 4,155,345. 22 May 1979. Priority date 24 Aug 1976, France, 2p.

The invention relates to a solar energy pick-up employing a stream of water, comprising an inclined surface on which substantially regular obstacles are arranged against the flow of the water arriving at the top of the inclined surface and collected at the bottom thereof, wherein the walls of the obstacles are reflecting and define channels for the passage of the water, whose depth is greater than five times their width.

4412 Solar energy collection tube. Mather, P.E.; Sherlock, S.T. (to Solarpower, Inc.). US Patent 4,151,828. 1 May 1979. Filed date 28 Jun 1977. 8p.

A cylindrical metal tube is provided with an outer transparent jacket, the jacket being spaced apart from the tube by bushings at each end and sealed therewith by means of o-ring type elastomeric seals positioned in grooves in the bushings. The intermediate space between the tube and the jacket is evacuated through a side tube on the jacket to reduce heat loss from the surface of the tube due to convection of air. The solar energy collector tube of this invention is applicable to flat plate type collector installations as well as concentrating collectors such as those employing parabolic trough reflectors. The flow path of the heat transfer fluid is straight through the tube, affording simple manifolding of multiple solar energy collection tubes arranged in parallel to span a specified area of collection.

4413 Explicit analysis of a natural circulation loop with reference to flat plate solar collectors. Sarma, P.K.; Al-Jubouri, A.S.; Al-Janabi, S.J. (Military Tech. College, Baghdad, Iraq). pp 795-802 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A simple dynamic analysis is presented with special reference to a natural circulation loop of a solar collector for two possible thermal conditions viz; a variable heat flux and a variable wall temperature. Some of the solutions, which may find application in the design are obtained explicitly.

4414 Experimental and theoretical performance study of solar collectors. Dabiri, A.E.; Grossman, G.; Bahar, F. (Arya Mehr Univ. of Tech., Tehran, Iran). pp 829-838 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Performance studies of four types of solar collectors have been made to determine their adaptability for domestic water and space heating systems in Iran. Flat-plate collectors with various forms of plate design and a parabolic type concentrating collector were considered. A specially designed test facility has been erected, where the collectors could be tested under steady state conditions. Flow rates, temperature and solar radiation measurements allowed for calculation of collected energy and efficiency. A numerical model has been developed to calculate heat losses from the collectors and to predict their performance. Experimental results are given and compared with the theoretical ones obtained from the numerical analysis. Performance characteristics, including collected heat and efficiency, are calculated.

4415 Cooling of a fluid by a nocturnal radiator. Boldrin, B. (Laboratorio per la Tecnica del Freddo del CNR, Padova, Italy); Scalabrin, G.; Lazzarin, R.; Sovrano, M. pp 839-851 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Atmospheric infrared radiative heat exchange has been investigated with regard to its cooling effect on a flat-plate radiator using an ir transparent wind screen. A computer program has been developed to determine the heat exchange available to cool a fluid circulating within the collector for a variety of operational and clear night-sky conditions. Along with the theoretical analysis, experiments were carried out by employing one of the most common flat-plate collector types and an automatic station according to the national solar energy program was built up. In this station, besides the usual actiometric data, downward atmospheric flux, ambient temperature, relative humidity and wind speed were continuously recorded and transferred to a computer via punch tape. The simultaneous knowledge of these parameters and of the cooling effect obtained by the collector allows to find out the efficiency of the cooling system.

HEAT STORAGE

REFER ALSO TO CITATION(S) 4227, 4273, 4370

4416 (CONF-780983—, pp 167-170) **Overview of storage.** Michaels, A.I. (Argonne National Lab., IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The current contract status, the significant technical accomplishments, and the future plans of the R & D Branch's program in thermal energy storage and heat exchange subsystems for solar system applications are briefly reviewed.

4417 (CONF-780983—, pp 171-172) **Experimental and numerical studies of thermal stratification in water tanks.** Wu, S.T. (Univ. of Alabama, Huntsville). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

An analysis of the effects of various degrees of temperature stratification on the overall performance of solar energy systems will be conducted with the TRNSYS code to determine potential benefits and guidelines in developing a more highly stratified tank.

4418 (CONF-780983—, pp 175-177) **Mathematical modeling of flow stratification in thermocline storage tanks.** Lin, E.I.H.; Sha, W.T. (Argonne National Lab., IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to develop and validate a three-dimensional, transient, single-fluid, single-phase mathematical model to (a) investigate effects of baffles, jetting, heat capacity of walls, heat source (or sink), and geometry on flow stratification in thermocline storage tanks; (b) study effects of flow stratification in storage tanks on performance of solar energy systems; and (c) conduct parametric studies to improve and/or optimize thermocline storage tank designs.

4419 (CONF-780983—, pp 178-180) **Handbook and guide for thermal energy storage applications in solar heating and cooling systems.** Schertz, W.W.; Cole, R.L. (Argonne National Lab., IL). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The main object of this project is to assemble and write a manual on the design and installation of thermal energy storage (TES) in solar heating and cooling systems. The audience is intended to be installers, contractors, engineers, architects, and designers who wish to enter the solar energy business. Although the manual is primarily intended for solar energy professionals, it is also capable of being used by do-it-yourselfers. Only data pertaining to state-of-the-art storage systems (water tanks and rock bins) will be presented in detail. Advanced storage systems such as phase-change or seasonal storage will not be included in the first edition of the manual, but may be included in future editions.

4420 (CONF-780983—, pp 181) **Thermal energy storage modules.** Ordway, F. (Artech Corp., Falls Church, VA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4421 (CONF-780983—, pp 182-183) **Developing and upgrading of solar system thermal energy storage simulation models.** Kuhn, J.K. Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Developing and Upgrading of Solar Systems Thermal Energy Storage (TES) Simulation Models is a program designed to develop high quality TES computer simulation models from state of the art information and make these models usable and available. Specifically: (1) collect, standardize, and link existing TES models from the literature and other contractors; (2) correlate TES models with available TES component test data; (3) develop streamlined versions of validated TES component models; and (4) provide DOE and industry with a competent solar TES simulation tool.

4422 (CONF-780983—, pp 184-185) **Series-Parallel solar augmented rock-bed heat pump.** Sowell, E.F. (California State Univ., Fullerton). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to establish the feasibility and cost effectiveness of the Series-Parallel system, which is a unique arrangement of solar collector, rock bed and heat pump as a residential environmental conditioning system. The objective is addressed in

four phases: (a) mathematical and computer model development, (b) subsystem performance mapping, (c) sensitivity analysis, and (d) conceptual design and system analysis.

4423 (CONF-780983—, pp 186-189) **Thermal storage in salt hydrates.** MacCracken, C.D. (Calmac Manufacturing Corp., Englewood, NJ). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective is to develop, test and make ready for the commercial market three different salt hydrate/heat exchanger modules with on-site filling techniques to cover storage of heat pump coolness (40 to 50 F), solar or heat pump space heating (100 to 120 F), and solar energy for absorption air conditioning or Rankine engines (200 to 260 F).

4424 (CONF-780983—, pp 190-192) **Direct contact liquid-liquid heat exchanger for solar heated and cooled buildings.** Ward, J.C. (Colorado State Univ., Fort Collins). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

Basic operational principles of a direct contact liquid-liquid heat exchanger are given. Some technical accomplishments during this report period are outlined. (MOW)

4425 (CONF-780983—, pp 193) **Development of intermediate temperature thermal energy storage systems.** Moszynski, J.R. (Univ of Delaware, Newark). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The ultimate objective of this project is the development of optimized thermal energy storage systems in the temperature range from 100°C to 300°C. Special consideration is to be given to the needs of contractors developing absorption, adsorption and Rankine cycle driven air conditioning systems. The first year effort is directed at identification and characterization of suitable storage materials.

4426 (CONF-780983—, pp 194-195) **Rock-bed storage for cooling.** Guyer, E.C. (Dynatech R/D Co., Cambridge, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to investigate and quantify, on a regional level, the cost and performance of using rock beds chilled by night air or air cooled by an evaporative cooler as a means of building cooling.

4427 (CONF-780983—, pp 196-198) **Analysis of advanced thermal energy storage subsystems for solar heating and cooling.** Offenhartz, P.O.D.; Marston, J.M. (EIC Corp., Newton, MA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this contract are to develop computer models for heating, cooling, and storage subsystems, particularly for advanced thermal energy storage devices; to simulate the performance of such subsystems; to compare their projected performance with more conventional subsystems based on sensible water tank storage; to gauge the role of advanced thermal energy storage subsystems in solar heating and cooling through systems simulation; and to suggest guidelines for further development of advanced thermal energy storage.

4428 (CONF-780983—, pp 199-200) **Self controlling, self pumping heat circulation system study.** Wachtell, G.P. (Franklin Research Center, Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The purpose of self pumping is to transport heat downward from solar collectors to thermal energy storage without using utility power to drive a circulator. The study objective was to define and evaluate self pumping schemes for residential applications, obtained from a survey of the literature, suggested by contacts with workers in the field, or conceived of by members of the project staff.

4429 (CONF-780983—, pp 201-202) **Thermal energy storage subsystem for solar heating and cooling applications.** Herrick, C.S. (General Electric Corp., Schenectady, NY). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The overall objective of this program is to develop the technology and the engineering data required to implement rolling cylinder thermal energy storage in solar energy systems. The purpose of this contract is to design and build a large, approximately 200,000 Btu prototype in an instrumented calorimeter. During the first year of the contract, the thermal characteristics of the system will be carefully defined and designs will be developed for the prototype rolling cylinder device and for its associated test equipment. During the second year of the contract, the prototype and test equipment will be constructed and preliminary checkout accomplished. A follow-on contract will be proposed the third year during which the prototype will be tested for its performance characteristics.

4430 (CONF-780983—, pp 203) **Solar applications of thermal energy storage.** Lee, C. (Hittman Associates, Inc., Columbia, MD). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4431 (CONF-780983—, pp 204) **Development of an improved water tank for thermal storage.** Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

4432 (CONF-780983—, pp 205-207) **Thermal storage for solar cooling using paired ammoniated salts.** Jaeger, F.A.; Haas, W.R. (Martin Marietta Corp., Denver, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this program are: to demonstrate feasibility of the concept and select the optimum salt pair through subscale system testing; to select the appropriate construction materials using compatibility test results, costs, and ease of fabrication; to investigate the practicality of the system by design and economic analysis of a residential unit; and to demonstrate the performance of the system by test of a full scale prototype unit.

4433 (CONF-780983—, pp 208-211) **Membrane-lined foundation systems for liquid thermal storage.** Bourne, R.C. (Univ. of Nebraska, Lincoln). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The overall project goal is to evaluate the potential for using membrane-lined foundations as economical and durable thermal storage sub-systems for solar heating installations. Alternate materials, foundation enclosures, heat exchange methods, and storage configurations will be considered in designing preferred membrane-lined storage systems of 250, 1500, and 5000 gallon size. Design concepts for increased temperature stratification within the storage container will also be developed.

4434 (CONF-780983—, pp 212-213) **Hybrid thermal storage with water.** Moriarty, M.P. (Rockwell International Corp., Canoga Park, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The primary objective of this contract is to develop parametric engineering data to aid in the evaluation and selection of hybrid storage systems, to establish storage system size and configuration, to evaluate the use of hybrid materials such as rock and earth, and to select tank types and configurations. It is expected that these results will be applicable to solar energy systems for both residences and commercial buildings.

4435 (CONF-780983—, pp 214-215) **Engineering design for thermocrete central storage units for low temperature solar application.** Chahroudi, D. (Suntek Research Associates, Corte Madeira, CA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

This project addresses the problem of developing detailed performance specifications, design criteria, and engineering blueprints for prototype phase-change thermal storage units for low temperature (7°C to 70°C) solar heating and cooling applications. The units are based on the use of phase-change materials (P.C.M.s) injected in modular foamed cement storage elements coated with epoxy rubber. This system, trade named Thermocrete, was developed by Suntek Research Associates' research program on phase-change thermal storage systems and has been further developed under contract to Department of Energy. A computer program that models the behavior of Thermocrete will be developed and used to size components and simulate the performance of the designs developed under this proposal. A set of engineering designs will be developed for units with air-to-air, air-to-water, and water-to-water heat transport fluids and phase-change temperatures at 7°C, 45°C, and 70°C. Targeted applications are phase-change thermal storage units for solar space heating, storage for domestic hot water, and cold side space cooling storage.

4436 (CONF-780983—, pp 216-221) **Performance of solar space heating systems using annual heat storage.** Hooper, F.C. (Univ. of Toronto, Ontario). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this study are generally to provide convenient and effective means for designing workable and economically optimal solar heating systems using annually cycled heat storage. Water has many advantages as the medium for such storages and is the principal system studied.

4437 (CONF-780983—, pp 222-223) **Analytical and experimental evaluation of a system for the annual collection and storage of solar energy.** Beard, J.T. (Univ. of Virginia, Charlottesville). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objectives of this research included the design, construction, testing and evaluation of a new system for year-round collection and storage of solar energy for the heating of buildings. A hot-water storage pool that stores energy in the form of sensible heat was sealed at the top with a solar collector subsystem, which acted not only to collect solar energy throughout the year, but also to limit the evaporative and convective heat losses from the storage subsystem. Standard instrumentation and measuring techniques along with a computer model and a digital computer model were used to aid in the engineering analysis of system performance.

4438 (CONF-780983—, pp 224-225) **Lightweight concrete materials and structural systems for water tanks for thermal storage.** Buckman, R.W. Jr. (Westinghouse Advanced Energy Sytems Div., Pittsburgh, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is the development of a 2,000 gallon size water storage system made with pre-cast or cast on-site, lightweight concrete (structural and insulating) elements possessing the necessary thermal/mechanical properties and capable of being easily assembled or fabricated, especially for retrofitting into and integration with existing residential and other structures.

4439 (CONF-780983—, pp 226-227) **Rock bed storage with heat pump.** Remmers, H.E. (ZIA Associates, Inc., Boulder, CO). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The project will establish the feasibility of mating a heat pump to a rock bed storage to effect optimal performance at the lowest cost in single family residences. A feasibility study and a cost effectiveness study will achieve this objective through: (1) analytical characterization of each subsystem; (2) control algorithm for the entire system; (3) definition of the various modes of operation; (4) analysis of the thermodynamic and energy transport phenomena; (5) optimization of initial and life cycle costs; and (6) recommended installation procedures for retrofit applications and new construction.

4440 (MLM—2657(OP)) **Heat extraction from a large, salt-gradient solar pond.** Harris, M.J.; Wittenberg, L.J. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 3p. (CONF-791105—1). Dep. NTIS, PC A02/MF A01.

From 2. annual solar heating and cooling systems operational results conference; Colorado Springs, CO, USA (27 Nov 1979).

The Miamisburg Solar Pond is the largest functional, salt-gradient solar pond in the US. It provides low-cost solar energy collection and low temperature heat storage. The heat in the pond is removed by use of a copper-tube heat exchanger which has a surface area of 138 m^2 (1500 ft^2). During the summer of 1979 the initial heat, 39,970 kW/h (136 million Btu), was removed for heating an outdoor community swimming pool. Based upon the performance thus far, the pond could yield 381,000 kW h/y (1300 million Btu/y) of useful heat. An economic analysis based upon a 10-y amortization of the installation costs of the pond indicates that the cost of the heat, 1.8 cents/kW h ($5.40/million Btu), is already below the current price for heating with fuel oil.

4441 (TULEA—1979-04) **Heat storage in naturally streaming ground water: a pilot study.** Holmbom, A. (Tekniska Hoegskolan, Luleaa (Sweden). Avd foer Vattenteknik). 1979. 30p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A method in which thermal energy is stored for the heating of a villa is described. Energy from a solar collector is fed to naturally streaming ground water during the summer. The energy is then utilized for space heating during the winter. Two closed systems are used. One system is used for the addition of energy to the ground water and the other one for the subtraction of energy from the ground water.

4442 **Solar energy storage and distributing device.** Gottier, P. US Patent 4,170,982. 16 Oct 1979. Filed date 17 Oct 1977. 8p.

An energy storage and distributing device having a heat storage chamber arranged for retaining heat which can be received from a solar collector arrangement or from a furnace or furnaces disposed within the chamber itself is described. Mounted on the chamber is a plenum arrangement disposed for directing warm fluid to a space to be heated, such as a room or rooms of a house, while a fluid distribution system is associated with the plenum and the chamber for alternately directing a fluid current directly into the plenum and directly into the chamber, and thereby supplying the plenum selectively with warm fluid from one of the chambers or from a source disposed outside the chamber. In this manner, solar energy, and the like, can be fed directly to the plenum, or stored in the chamber, or if solar energy is not available for whatever reason, and insufficient heat energy is present in stored form within the chamber, a furnace or furnaces can be employed to supply the requisite heat energy. By this arrangement, heating is provided for heating buildings of various kinds in the most efficient and economical manner, and when a plurality of furnaces are provided, with whatever fuel may be available. The chamber is advantageously provided with a heat storage medium including layers of rocks separated by layers of discrete articles preferably constructed from cast iron or other suitable heat storing material and being in the form of a multi-pointed star which permits fluid flow through the separating layers of discrete articles to enhance circulation of the fluid being heated through the heat storage chamber. 5 claims.

4443 **Storage tank especially suitable for use in a solar heat system.** Haug, H.W.; Shon, G.M.; Lenhardt, A.P. US Patent 4,169,461. 2 Oct 1979. Filed date 27 Oct 1977. 12p.

A storage tank especially suitable for use in a solar heat system utilizing water to store its collected heat is disclosed herein and includes a main body which defines an internal compartment for containing the water. This main body includes a composite inner layer for preventing the passage of water therethrough, an intermediate layer of thermal insulation having an R value between about R-20 and R-35 and outer layer for substantially preventing the passage of water therethrough. The storage tank when utilized as part of a solar heat system also includes an arrangement for passing water directly into and out of the internal compartment and an arrangement adapted to support at least one heat exchanger within the compartment.

4444 **Temperature regime in hothouses with solar energy accumulation and closed hydrologic cycle.** Bairamov, R.; Rybakova, L.E. pp 517-525 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A ground heat accumulator is mounted in the back wall of the greenhouse consisting of troughs filled with moist soil. Temperature and humidity conditions were studied during several seasons of operation. (MHR)

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

4445 (AD-A—062136) **Geothermal potential at US Air Force bases. Final technical report January 1977-September 1978.** Austin, C.F.; Whelan, J.A. (Naval Weapons Center, China Lake, CA (USA)). Nov 1978. Contract PRO-77-0021. 61p. NTIS PC A04/MF A01.

The Air Force has completed a study of the geothermal potential of USAF bases. This report lists the power generation potential, space or industrial heating potential, and geopressure potential at each USAF base. This report also discusses in detail the data available for those USAF base which exhibit the greatest potential for use of geothermal energy. Bases with significant potential that are discussed in detail include: Mountain Home (space heating), Saylor Creek Range at Mountain Home (power), Ellsworth Air Force Bases (space heating); Keesler Air Force Base (geopressurized geothermal resource*), Hill Air Force Base (space heating), and William Air Force Base (power) in the Continental United States and Bellows Air Force Base, Hawaii (Power), Lajes Air Force Base, Azores (power), and Ankora Air Station, Turkey (space heating) outside of the Continental United States. Open literature and unpublished field studies provided the basis for evaluation. (Author)

USA

4446 (RLO—1040) **Geothermal resource assessment of Mount Hood. Final report.** Hull, D.A. (Oregon Dept. of Geology and Mineral Industries, Portland (USA)). Jul 1979. Contract EG-77-C-06-1040. 198p. Dep. NTIS, PC A09/MF A01.

The contract research and results are reviewed briefly. Four reports of research conducted under subcontract are abstracted separately. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

REFER ALSO TO CITATION(S) 4446

4447 (COO—2686-1) **Feasibility study of the Conway Granite as a geothermal energy resource.** Osberg, P.H.; Wetterauer, R.; Rivers, M.; Bothner, W.A.; Creasy, J.W. (Maine Univ., Orono (USA). Dept. of Geological Sciences). 15 Aug 1978. Contract EY-76-S-02-2686. 203p. Dep. NTIS, PC A10/MF A01.

The eastern part of the White Mountain batholith is dominated by four intrusive complexes, which contain similar sequences of intrusive rocks. Although the details of the sequence of intrusion differ from complex to complex, the Osceola Granite is generally an early phase, followed by the development of ring dikes of Albany Porphyritic Quartz Syenite and finally the intrusion of Conway Granite. One intrusive complex contains riebeckite granite as a late phase, and at least two complexes fed volcanic eruptions, some of the products of which are preserved in subsided blocks. A specialized study of the orientation of joints was made in the eastern halo of the batholith. Measurement of gravity over the eastern part of the batholith and reduction of these data allows gravity residuals to be calculated and two- and three-dimensional models for the eastern part of the batholith to be constructed. The gravity models are consistent with steeply dipping contacts with the country rocks, and the maximum depth of the eastern part of the batholith is between 4 km and 5.25 km. The temperature distribution within the eastern part of the batholith can be determined using existing parameters for heat flow, heat production, and conductivity augmented by new data for heat production. The geologic boundaries and the gravity model provide the geometric constraints for the temperature distribution. Both one- and two-dimensional models are developed. The temperature distribution varies both vertically and laterally within the batholith. Estimates of temperature beneath the batholith are 170°C at 6 km and 220°C at 8 km.

4448 (RLO—1040, pp 5-77) **Stratigraphy and structure of the Columbia River Basalt Group in the Cascade Range, Oregon.** Beeson, M.H.; Moran, M.R. (Portland State Univ., OR). Jul 1979.

In Geothermal resource assessment of Mount Hood.

The Columbia River Basalt Group lava flows identified in the Mt. Hood area of the Oregon Cascade Range are assigned to the Grande Ronde Basalt and Wanapum Basalt formations of the Yakima Basalt Subgroup, except for three intercalated flows of Prineville chemical type. The composite section has a stratigraphic thickness of approximately 550 m and consists of 26 flows that can be separated into eight distinct geochemical and/or magnetic polarity subdivisions. Deformation began during the incursion of the Grande Ronde Basalt and is represented by NE trending folds traversing the Cascade Range which have structural relief of approximately 300 m and by an echelon NNW to NW trending folds and faults that occur from the Clackamas River area to Portland along the Portland Hills-Brothers fault trend. The major exposures of CRB utilized in this study are: Clackamas River Area; Bull Run Watershed; Hood River Drainage and Hood River fault zone; and the Salmon River Area.

4449 (RLO—1040, pp 78-136) **Geology and geochemistry of Mt. Hood volcano.** White, C.M. (Univ. of Oregon, Portland). Jul 1979.

In Geothermal resource assessment of Mount Hood.

The lavas that comprise Mt. Hood volcano can be divided on the basis of their age and modal composition into three suites: (1) the sequence of pyroxene and hornblende andesites that was erupted prior to the last glaciation and which comprises about 90 percent of the volcano; (2) the post-glacial hornblende dacites that were erupted primarily as hot avalanche flows from domes near the summit; and (3) the flows of olivine andesite that were erupted from several satellite vents on the flanks of Mt. Hood. New compositional data for the Main-Stage lavas and the post-glacial dacites are reported.

NON-USA

REFER ALSO TO CITATION(S) 4450

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 4446

4450 (LUTVDG/(TVGL—3003)/1-95/(1979)) **Exploitation of geothermal energy in Skaane, Sweden.** Bjelm, L.; Hartlen, J.; Bennet, J.; Bruch, H.; Persson, P.G.; Roeshoff, K. (Tekniska Hoegskolan, Lund (Sweden)). Jan 1979. 106p. (In Swedish). Dep. NTIS (US Sales Only), PC A06/MF A01.

The possibilities for exploiting geothermal energy in Skaane, Sweden, were analyzed. One of the aims of this work was to find prospecting techniques useful for this area. Two possible geothermal prospecting techniques have been studied, viz. temperature measurements in trial drill holes and geothermometry.

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 4447

4451 (RLO—1040, pp 137-188) **Gravity measurements in the area of Mount Hood, Oregon.** Couch, R.; Gemperle, M. (Oregon State Univ., Corvallis). Jul 1979.

In Geothermal resource assessment of Mount Hood.

The analysis of gravity measurements at 337 stations on and about Mount Hood indicate lateral and vertical variations in the density of the flows and pyroclastics in and beneath Mount Hood. Complete Bouguer gravity anomalies indicate that the axis of Mount Hood is located on an elongate gravity high, oriented approximately N75E. Mount Hood is superimposed on a gravity low that extends from north of the mountain to the southern extent of the survey area. The gravity low suggests a north-south oriented graben-like structure. Prominent lineations in the gravity anomalies oriented approximately N23W occur both northwest and southwest of Mount Hood. A simple cone-on-a-cylinder model for the core of Mount Hood agrees with the gravity anomalies. Long wavelength anomalies suggest that undulations in the Columbia River Basalts beneath and about Mount Hood range from less than 500 m to over 1400 m above sea level. Porosities of the average rocks which comprise Mount Hood are estimated to be approximately 20 to 30 percent and the density is approximately 2.27 gm/cm^3.

4452 (RLO—1040, pp 190-264) **Heat flow modeling of the Mount Hood volcano, Oregon.** Blackwell, D.D.; Steele, J.L. (Southern Methodist Univ., Dallas, TX). Jul 1979.

In Geothermal resource assessment of Mount Hood.

Some examples of simple cooling models with different shapes of magma chambers that might be associated with stratocone volcanoes are discussed. These simple models are calculated in order to investigate the effects of different geometry on the total heat transfer of the system, rate of cooling, and volcanic recurrence times necessary to keep the crust hot. A description of a detailed study of the Western Cascade-High Cascade boundary in the Western Cascade province is discussed along with the results of heat flow studies along the eastern boundary of the Northern Cascade Range of Oregon. These studies are presented here for completeness and for comparison with the data obtained in the Mt. Hood region. A discussion is presented of the heat flow in the vicinity of Mt. Hood, including near-regional exploration holes, and deep exploration holes at Timberline Lodge and at Old Maid Flat at the foot of the Mt. Hood volcano.

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 4449

4453 **Chemical analyses of thermal springs and wells in Oregon.** Washington, DC; Geological Survey (1079). 171p. (USGS-OFR—0-79-3).

Chemical analyses were derived from specific samples collected of water, condensate, or gas from thermal surface springs or wells in Oregon. The information presented is included in the Geothermal Resource Computer File (GEOTHERM). Specific conductance is reported in μmohs/cm. Alkalinity is reported in either ppM or mg/l as $CaCo_3$. Solute analyses as well as total dissolved solids are reported in either ppM or mg/l as noted. Water temperatures are Celsius (°C). Counties are listed alphabetically for each format and localities are treated similarly. Some springs may have more than one locality, and this is reflected on the data sheets.

EXPLORATORY DRILLING AND WELL LOGGING

4454 (LBL—9090) **Measurement requirements and methods for geothermal reservoir system parameters: an appraisal.** Lamers, M.D. (Measurement Analysis Corp., Torrance, CA (USA)). Aug 1979. Contract W-7405-ENG-48. 48p. (GREMP—6). Dep. NTIS, PC A03/MF A01.

One of the key needs in the advancement of geothermal energy is the availability of adequate measurements to aid the reservoir and production engineer in the development and operation of geothermal reservoirs, wells and the overall process plant. This report documents the geothermal parameters and their measurement requirements and provides an appraisal of measurement methods and instruments capable of meeting the requirements together with recommendations on identified deficiencies.

LEGAL AND INSTITUTIONAL ASPECTS

4455 Preliminary report on the Pacific Gas and Electric Company's notice of intention to seek certification for Geysers Unit 16 (78-NOI-6). Sacramento, CA; California Energy Commission (1979). 333p. (NP—24093).

The preliminary findings of fact and conclusion adopted by the Commission Committee are presented. Also, a description of the proposed project, a summary of the proceedings to date, and local, state, and federal government agency comments on the proposal are included. Preliminary findings and conclusions are presented on: (a) conformity to the forecast of statewide and service area electric power demands; (b) the degree to which the proposed site and facility conform with applicable local, regional, state, and federal standards, ordinances and laws; (c) the safety and reliability of the facility; and (d) the relative merit of the proposed transmission line corridors. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 4459

4456 (UCID—18212) **Imperial Valley environmental project: baseline air quality and meteorological data.** Gudiksen, P.H.; Lamson, K.C.; Axelrod, M.C.; Fowler, V.; Nyholm, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 26 Sep 1979. Contract W-7405-ENG-48. 502p. Dep. NTIS, PC A22/MF A01.

The baseline air quality and meteorological data are gathered by the Imperial Valley Environmental Project from December 1976 through April 1978. The air quality data obtained at the six fixed locations are reported in the form of histograms; histograms and wind roses are presented of the meteorological data collected at the six sites. The air quality and meteorological data obtained by the mobile laboratory in the vicinity of the Heber KGRA are listed in a similar format. (MHR)

4457 (UCRL—15108) **Remote sensing for geothermal environmental assessments. Final report.** Frei, W.; Shibata, T.; Huth, G.C. (University of Southern California, Marina Del Rey (USA)). 30 Jun 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

The role of remote sensing is examined in the context of the DOE Environmental Assessment Studies. Particular attention has been paid to the exploitation, by computer analysis, of low altitude aerial photographs, which had been made available for this project. One technique, change detection - developed during this project - has been found to be particularly useful, because it permits to detect environmental changes at a very early stage where it might escape detection on the ground. This technique, which has now been perfected to be usable on a routine basis, can thus provide a very effective environmental early warning capability. Several examples are shown in known Geothermal Resource Areas (KGRA's) in the Imperial Valley and the Geysers, California, which lead to the conclusion that remote sensing should become an essential tool for the Environmental Assessment Studies.

4458 (UCRL--52797) **Potential air quality impact of geothermal power production in the Imperial Valley.** Gudiksen, P.H.; Ermak, D.L.; Lamson, K.C.; Axelrod, M.C.; Nyholm, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

A regional assessment of the potential impact on air quality of developing the Imperial Valley's geothermal resources for power production is presented. A network of six stations was installed to characterize the air quality and atmospheric transport properties of the valley before development. These measured the ambient air concentrations of H_2S, SO_2, O_3, NO, NO/sub x/, CO_2, Hg, Rn, and particulates. Wind velocity and the directional variability of the winds were also measured to determine atmospheric stability. The geothermal fluids were analyzed chemically to estimate potential emission rates of H_2S, NH_3, CO_2, CH_4, Hg, and Rn from future power plants. Using these data and advanced air quality modeling led to the prediction of the potential valley-wide impact of a 3000 MW development scenario. The impact analysis reveals that H_2S is the principal gaseous pollutant of concern due to its noxious odor and the potential release rate. The ambient H_2S concentrations that would result from generating 3000 MW without emission controls exceed the California air quality standard (30 ppb) at least 1% of the time for an area in the northern part of the valley that is roughly 1500 km^2 in size. This compares with current ambient air concentrations that exceed the standard much less than 0.1% of the time. The population center most impacted is Calipatria, where the standard could be exceeded almost 10% of the time. In addition, the odor of H_2S will be noticeable at least 1% of the time for most of the valley if the 3000 MW are placed on-line without abatement systems.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 4455, 4480

4459 (DOE/EIS—0049-D) **Draft environmental impact statement. Geothermal Demonstration Program: 50 MWe power plant, Baca Ranch, Sandoval and Rio Arriba Counties, New Mexico.** (Department of Energy, Washington, DC (USA)). Jul 1979. 313p. Wm. H. Pennington's Office, Headquarters, Washington, DC.

The proposed demonstration plant will be located within the Valles Caldera at the Baca location near Los Alamos, New Mexico. The proposed power plant is a single-flash steam unit generating 50 MW(e) gross from 710-kPa steam to be supplied by up to 14 or 17 geothermal wells from the liquid-dominated reservoir. This analysis evaluated the potential environmental impacts resulting from well drilling, pipeline construction, and geothermal fluid withdrawal; from power plant construction and operation; and from transmission line construction for the demonstration plant. The potential consequences of further commercial development of geothermal energy beyond 50 MW(e) in the area as a result of a successful demonstration are discussed in a more general way. (MHR)

DIRECT ENERGY UTILIZATION

4460 (NMEI—41) **Feasibility study of geothermal energy for heating greenhouses. Final report.** LaFrance, L.J. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jun 1979. 22p. New Mexico Energy Institute, Las Cruces.

The technical feasibility of heating greenhouses with geothermal heat is established. Off-the-shelf equipment suitable for geothermal heating is readily available. A procedure is given to economically examine a geothermal site for its suitability. Generally, geothermal heating systems are capital intensive. Where the geothermal energy is free the geothermal system is very attractive and where the cost of geothermal heat is the same as other energy, Btu/$, geothermal heat is unattractive.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 4147

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 4167

4461 (LUTMDN/TMVK—3072/1-6(1978)) **Instrument for the registration of discrete values of processes varying with the time.** Briksson, B.; Helgesen, H. (Tekniska Hoegskolan, Lund (Sweden). Inst. foer Vaerme- och Kraftteknik). Aug 1978. 8p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

An instrument for the registration of duration characteristic curve of the wind at discrete measuring points is described.

TURBINE DESIGN AND OPERATION

4462 (DOE/NASA/20370—79/18) **Modified aerospace reliability and quality assurance method for wind turbines.** Klein, W.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EX-76-A-29-1004. 8p. (NASA-TM—79284). Dep. NTIS, PC A02/MF A01.

The Safety, Reliability and Quality Assurance (SR & QA) approach developed for the first large wind turbine generator project, MOD-OA, is described. The SR & QA approach to be used had to assure that the machine would not be hazardous to the public or operating personnel, would operate unattended on a utility grid, would demonstrate reliable operation and would help establish the quality assurance and maintainability requirements for future wind turbine projects. Since the ultimate objective of the wind energy program is to provide wind power at a cost competitive with other energy sources, the final SR & AQ activities were to be accomplished at a minimum of cost and manpower. The final approach consisted of a modified Failure Modes and Effects Analysis (FMEA) during the design phase, minimal hardware inspections during parts

fabrication, and three simple documents to control activities during machine construction and operation.

4463 (LUTMDN/TMVK—3070/1-31/(1978)) **Cyclic variations of the load angle of wind turbines with torsion axis.** Eriksson, B.; Helgesen, H. (Tekniska Hoegskolan, Lund (Sweden). Inst. foer Vaerme- och Kraftteknik). Aug 1978. 33p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The cyclic variations of the load angle of a wind turbine connected to a strong field have been investigated. The assembly is looked upon as two masses connected with a non-rigid shaft. A step moment is applied to the mass equal to the mass of the wind rotor and load angle is studied. The differential equation of the system is solved by applying the Euler's modified method. In this way the effect of the sizes of the masses and the softness of the shaft on the cyclic variation at disturbances could be studied. The results are presented in graphs.

4464 (NP—24145) **Low-cost water pumping windmill using a sail-type Savonius rotor. Report 79 FM 2.** Govinda Raju, S.P.; Narasimha, R. (Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering). Jan 1979. 107p. Dep. NTIS (US Sales Only), PC A06/MF A01.

Portions of document are illegible.

A water pumping windmill which can be built largely using materials and skills available in rural areas has been designed and fabricated. The windmill uses a Savonius rotor and incorporates a novel sail-type construction. The pump is of positive displacement type using the casing of a pneumatic type for the pumping chamber. Two prototypes have been constructed and these have indicated a reasonable performance and reliability.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 4603, 4604, 4607

4465 (EPRI-RD—5(Vol.1)) **Digest of current research in the electric utility industry.** Andrews, K.; Berkey, R.; Gray, K.; Pakulski, R.; O'Gara, M. (Informatics, Inc., Rockville, MD (USA). Data Base Information Services Div.). Jul 1979. 472p. Dep. NTIS, PC A20/MF A01.

A major objective of EPRI is to be a prime source of information on R and D activities in the field of electric energy. In keeping with this objective, EPRI developed the Research and Development Information System (RDIS) in 1974. RDIS is a computerized data base of research projects sponsored by EPRI and by individual electric utilities throughout the United States. Its purpose is to provide the utility industry with a single, authoritative source of information on R and D projects in progress and recently completed. The availability of such data will help to reduce duplication of research activities and will assist in broadening the use of new and improved technology throughout the electric utility industry. The heart of the Research and Development Information System (RDIS) is a computerized on-line data base containing approximately 5700 records on R and D projects. New projects, changes reflecting progress, changes in research objectives, and updated funding information are entered as supplied by the utilities, thus keeping the data base current. The Digest of Current Research, issued annually, is photocomposed from the data base. This issue, in 2 volumes, represents the data base as of July 1979. Entries are arranged by the subject categories listed in Appendix B and are identified by a sequential location number. Subject and corporate indexes list the location number, permitting the user to go directly to the entry in the text of the Digest. Volume 1 contains information in the categories of: general R and D support; hydroelectric power; nuclear power; fossil fuels; and advanced power systems. (LCL)

4466 (EPRI-RD—5(Vol.2)) **Digest of current research in the electric utility industry.** Andrews, K.; Berkey, R.; Gray, K.; Pakulski, R.; O'Gara, M. (Informatics, Inc., Rockville, MD (USA). Data Base Information Services Div.). Jul 1979. 564p. Dep. NTIS, PC A24/MF A01.

A major objective of EPRI is to be a prime source of information on R and D activities in the field of electric energy. In keeping with this objective, EPRI developed the Research and Development Information System (RDIS) in 1974. RDIS is a computerized data base of research projects sponsored by EPRI and by individual electric utilities throughout the United States. Its purpose is to provide the utility industry with a single, authoritative source of information on R and D projects in progress and recently completed. The availability of such data will help to reduce duplication of research activities and will assist in broadening the use of new and improved technology throughout the electric utility industry. The heart of the Research and Development Information System (RDIS) is a computerized on-line data base containing approximately 5700 records on R and D projects. New projects, changes reflecting progress, changes in research objectives, and updated funding information are entered as supplied by the utilities, thus keeping the data base current. The Digest of Current Research, issued annually, is photocomposed from the data base. This issue, in 2 volumes, represents the data base as of July 1979. Entries are arranged by the subject categories listed in Appendix B and are identified by a sequential location number. Subject and corporate indexes list the location number, permitting the user to go directly to the entry in the text of the Digest. Volume 2 contains information in the categories of: transmission; distribution; stations and substations; consumer utilization; economics; personnel; area development; and environmental assessment. (LCL)

POWER PLANTS AND POWER GENERATION

4467 (PB—293561) **Theoretical study of the dynamic response of a chimney to earthquake and wind.** Yang, T.Y.; Shiau, L.C.; Lo, H.; Bogdanoff, J.L. (Purdue Univ., Lafayette, IN (USA). School of Aeronautics and Astronautics). 1 Apr 1978. 149p. NTIS PC A07/MF A01.

Analytical studies of the elastic and inelastic responses of a chimney to an earthquake are performed. The chimney studied is at the steam generating plant at Paradise, Kentucky of Tennessee Valley Authority. The report describes the geometry and the material property of the chimney at a TVA Power Plant. An existing computer program SAP IV is employed to study the elastic response of the chimney. Both time history and response spectrum analyses are employed to obtain the displacements and forces at various heights of the chimney. A simple method is developed to generate the ground response spectrum as the input data for the response spectrum analysis. In the description of the inelastic response of a chimney to an earthquake, the plastic bending analysis of a chimney is described first. By using the initial strain concept to treat the effects of plastic strains, a governing linear matrix equation is established. Based on the equations and the procedure developed, the behavior of a chimney subjected to cyclic loading is then analyzed. A general equation for the relationship between moment and curvature is derived. The plastic strain distributions in the element at any stage are found through this relationship. Finally, the inelastic response of the chimney is solved by using a step-by-step integration method coupled with the governing equations and the moment curvature relationship. A computer program is developed to predict the inelastic dynamic behavior of the chimney.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

4468 (PB—292504) **Theoretical study of the earthquake response of the Paradise cooling tower.** Yang, T.Y.; Gran, C.S.; Bogdanoff, J.L. (Purdue Univ., Lafayette, IN (USA). School of Aeronautics and Astronautics). 3 Apr 1978. 65p. NTIS PC A04/MF A01.

Since the use of cooling towers is increasing over the use of once-through water cooling systems, and since many of these towers are being built in regions of high seismic risk, their dynamic behavior has received considerable attention. In this study, quadrilateral plate finite elements and beam finite elements, both oriented arbitrarily in 3-dimensional space, are used in the analysis of the dynamic behavior of cooling towers. It is found that such a model will accurately predict natural frequencies and mode shapes. It also provides a realistic modeling of the base support system, important in the prediction of displacements and stresses in the base region. A model of a cooling tower in the TVA's 1200 MW fossil fuel steam generating plant in Paradise, Kentucky is used in the study. The report describes the system, its finite elements, methods of analysis, assumptions, evaluative analysis, and free vibration analysis of the Paradise cooling tower.

4469 (PNL—2746) **Augmented dry cooling surface test program: analysis and experimental results.** Parry, H.L.; MacGowan, L.J.; Kreid, D.K.; Wiles, L.E.; Faletti, D.W.; Johnson, B.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 244p. Dep. NTIS, PC A11/MF A01.

Experiments were performed to assess the operating characteristics and potential performance of water-augmented dry cooling systems. The work was aimed at evaluating a deluged air-cooled HOETERV plate fin heat exchanger surface proposed for integrated dry/wet cooling systems and using test results to guide the development of a predictive analytical model. In the process, all-dry performance data were obtained for the HOETERV surface as well as for two Curtiss-Wright chipped fin surfaces. The dry heat transfer data indicate that a slotted Curtiss-Wright surface slightly outperforms the HOETERV and nonslotted Curtiss-Wright surfaces based on heat rejection rate per unit of fan power. However, all three surfaces are so close in performance that other factors, such as surface cost and piping and mounting costs, will probably determine which surface is preferred at a given installation. Comparisons of

deluged HOETERV performance with dry HOETERV and Curtiss-Wright performance under prototypic conditions have established that deluging can provide considerable heat rejection enhancement, particularly at low ITD and low air humidity. A deluged HOETERV core operating at a 115°F primary fluid temperature in 105°F air at 10% relative humidity can reject over 7 times as much heat as a dry HOETERV core operating under the same conditions at the same air-side pressure drop. Deluged tests were performed to evaluate the effect of airflow rate, deluge flow rate and core tilt angle on performance. Both increased airflow and increased deluge flow increase both heat rejection rate and required fan power. Optimal airflow rate will thus be determined for a given location by the competing costs of heat exchanger surface area versus fan operation. Changes in core tilt angle from vertical to 16° from vertical have a negligible effect on performance.

POWER CYCLES

REFER ALSO TO CITATION(S) 4480

4470 (ORNL/TM—6626/V1) **Assessment of an atmospheric fluidized-bed coal-combustion gas-turbine cogeneration system for industrial application.** Graves, R.L.; Holcomb, R.S.; Tallackson, J.R. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 182p. Dep. NTIS, PC A09/MF A01.

This study was initiated to provide information on the future potential industrial market for a cogeneration system consisting of a fluidized-bed coal combustor coupled to a gas-turbine (Brayton cycle) power system that uses air as the working fluid. In assessing the potential applications for the system, the process heat energy consumption by industry is identified, with special detail included on the six most energy-intensive industries. The potential impact on the nation's oil and natural gas consumption that would result from wide-spread utilization of coal for process heat is also estimated. The fraction of industrial process heat that the system could feasibly satisfy from a thermodynamic viewpoint is estimated, and the performance (potential fuel efficiency and heat/power ratio) of the atmospheric fluidized-bed gas-turbine system is calculated. Also treated are several specific case studies of industries in which the system could be incorporated. Major parameters are specified, and flow sheets are derived for systems that would satisfy the heat and power requirements of the process or industry. The overall fuel utilization efficiency, thermal power rating, and potential number of installations are specified for these case studies. The findings of the study indicate that there is a sizable potential market for the system, with over 1000 possible installations disclosed after reviewing only 8 specific industries from 6 major Standard Industrial Classification (SIC) groups. The potential displacement of oil and gas by coal in process heating is shown to be about 1.60 m^3/sec (870,000 bbl/d) of oil and 4590 m^3/sec (14.0 billion ft^3/d) of natural gas for all industries combined. Continued development of the fluidized-bed coal combustor and power system is recommended so that this potential may be at least partially realized.

4471 **Pacific Gas & Electric Company's notice of intention to seek certification for Pittsburg Power Plant Units 8 & 9.** Sacramento, CA; California Energy Commission (1979). 169p. (NP—24097). The Publisher, 1111 Howe Ave., Sacramento, CA 95825.

On April 21, 1978, Pacific Gas and Electric Company (PG & E) filed with the California Energy Commission a Notice of Intention (NOI) to file an Application for Certification (AFC) of two combined-cycle electrical generating units proposed for construction in northern Contra Costa County near the City of Pittsburg (Pittsburg 8 and 9). This Preliminary Report on the Pittsburg 8 and 9 proposal was prepared pursuant to California Public Resources Code Sections 25510 and 25512. It presents the preliminary findings of fact and conclusions of law of the Commission Committee (Ronald D. Doctor, presiding, and Richard L. Maullin) assigned to conduct proceedings on the NOI. Additionally, the Preliminary Report contains a description of the proposed project; a summary of the proceedings to date; comments on the proposal from local, regional, state, and federal agencies; and an outline of those issues to be considered in future proceedings on the NOI.

COMPONENTS

REFER ALSO TO CITATION(S) 4480

4472 (EPRI-FP—1127) **High-temperature ceramic heat exchanger. Final report.** Coombs, M.; Kotchick, D.; Warren, H. (AiResearch Mfg. Co., Torrance, CA (USA)). Jul 1979. 366p. Dep. NTIS, PC A16/MF A01.

The results of an 18-month effort directed to developing the technology necessary to build a ceramic heat exchanger for operation with a small (200-hp) closed-Brayton-cycle engine are described. The ceramic heat exchanger operates with 3000°F combustion products on one side and heats high-pressure Argon gas, which subsequently is delivered to the turbine, to 1800°F. The design consisting of an array of siliconized-silicon carbide U-tube modules employing 180 1-in.- dia finned tubes was selected. An extensive materials data base was obtained on the Norton Company's NC-430 grade siliconized-silicon carbide, and to a lesser extent on Carborundum's sintered alpha silicon carbide (SASC). 250 basic material tests were conducted on various test specimens. The materials test program encompassed strength tests, cyclic fatigue tests, and stress rupture tests from room temperature to a maximum of 2950°F (SASC only). Strength data were compiled on Weibull plots for application to the design effort. A subcontract was let to develop the required ceramic fabrication technology to produce the heat exchanger components. Finned tubes, manifolds, and U-tube sections were produced to specifications. Several complete heat exchanger modules incorporating the major design features of the engine heat exchanger configuration were designed and fabricated. Various tests were conducted on the ceramic components produced to relate the actual strength characteristics of the components to predictions based on the material test specimens. Complete heat exchanger modules were produced and tested under simulated engine operating conditions up to 2300°F tube wall temperatures. Heat transfer performance and pressure drop experiments were performed. Based on the experimental data collected, lifetime/reliability predictions were made for the ceramic heat exchanger designed for the original engine application.

4473 (EPRI-NP—902) **On-line monitoring and diagnostic systems for generators. Final report.** Emery, F.T.; Haley, P.H.; Brandt, G.B.; Gottlieb, M. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). Sep 1979. 294p. Dep. NTIS, PC A13/MF A01.

The purpose of EPRI Research Project 970 is to increase plant availability by developing an on-line monitoring and diagnostic system for electric generators. The system's objectives are to detect equipment failures early enough to warn operators of the impending failure, and to inform maintenance personnel in advance about the nature of the failure. The project began with a survey of recent generator outages to determine which monitoring techniques would most likely reduce outage costs. Two of the most promising techniques were then developed further. They were radio frequency (rf) monitoring to detect generator arcing, and temperature monitoring using optical fibers to detect localized overheating. The project concluded with the conceptual design of a monitoring system capable of detecting incipient failures while discriminating against false alarms.

4474 (ORNL/TM—6253) **Summary of the research and development effort on open-cycle coal-fired gas turbines.** Lackey, M.E. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 126p. Dep. NTIS, PC A07/MF A01.

Extensive experience gained with gas turbines operating not only with coal as fuel but also with dusty inlet air and with dirty fuels (such as heavy oils and blast furnace gas) as well as petroleum catalytic cracking units was reviewed. All this experience indicates that the particulate content of the hot gases fed to the turbine must be kept to less than ~ 1 ppM to keep turbine bucket erosion to an acceptable level for turbine inlet temperatures of 1500°F or more. Dropping the turbine inlet temperature below 1110°F makes it possible to obtain turbine bucket lives of around 3 yr with ~ 100 ppM of particulates if a number of compromises are made in the turbine design. A buildup of deposits in the turbine is a serious problem if sulfates or chlorides are present in the gas stream and the turbine inlet temperature is above ~ 1110°F. At this temperature level, these materials become soft and sticky and form films on the blades that accumulate deposits of the silicates and oxides present in the ash of a coal-fired combustor. Extensive experience with many types of cyclone separators shows that they can be used to reduce the particulate content to as low as ~ 100 ppM under the best conditions. Granular bed filters have yielded similar performance. Electrostatic precipitators are not effective above ~ 1110°F because the dust deposits on insulators become conducting and short out the grids. The only effective way found to reduce the particulate content of blast furnace gas and gas from coal gasification units to the ~ 1 ppM required for a high-temperature gas turbine is to cool the gas and pass it through a two-stage water scrubber or equivalent before burning it. In brief, it appears doubtful that any of the hot-gas clean-up concepts being investigated will yield the low particulate contents required for the satisfactory, economical operation of 1500 to 1600°F long-lived gas turbines.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 4470, 4709

ECONOMICS

4475 **Evaluation of four marginal costing methodologies.** Lexington, MA; Temple, Barker and Sloane, Inc. (1979). 109p. (NP—

22576). Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303.

The four marginal costing methodologies most frequently considered for the US electric utility industry are evaluated. They are generally referred to by the authors' names: Cicchetti, Gillen, and Smolensky; Ernst and Ernst; Gordian Associates; and National Economic Research Associates. Following an extensive executive summary and an introductory chapter, Chapter II contains a brief review of the principles of economic theory and marginal cost pricing followed by a discussion of the relevant criteria for evaluating the methodologies. Chapter III summarizes the operation of each of the methodologies; Chapter IV contains the conceptual analysis and evaluation of the methodologies using the criteria specified in Chapter II. Chapter V presents a quantitative analysis of the methodologies. The final chapter integrates the findings of the conceptual and quantitative analyses and describes the fundamental differences among the four marginal costing methodologies.

4476 Vermont state revenues and expenditures generated by a 50-MW wood-fired power plant. Segerson, K. Hanover, NH; Dartmouth College (1978). 24p. (DSD—109).

Estimates have been made of the amount of revenue that the state of Vermont would collect annually either directly or indirectly from the construction and operation of a $59 million, 50-megawatt wood-fired power plant (WFPP). Sources of income will be income and sales taxes (General Fund revenues) and truck registration fees (Highway Fund revenues). Calculations show that the state could collect over $800,000 in additional revenue during each year of construction of the WFPP and over $1,250,000 during each year of operation. Preliminary estimates indicate that increased state expenditures caused by such a plant will be minimal during construction and under $125,000 per year during operation. The increased revenue is more than adequate to cover these additional expenditures, and thus the state would realize a net increase in income as a result of the plant's presence.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 4541

FUELS

REFER ALSO TO CITATION(S) 4008, 4606

4477 (DOE/EIA—0075/3(78)) **Cost and Quality of Fuels for Electric Utility Plants monthly report: Energy Data Reports. FPC Form No. 423, data for March 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 65p. Dep. NTIS, PC A04/MF A01.

This report summarizes the cost and quality of fossil fuels delivered to electric utilities generating plants in the US for the month of March 1978. It includes fuel cost and quality data on a plant-by-plant basis, grouped by state and geographic region. Also contained in the report is information on fuels delivered to peaking units such as combustion turbines, internal combustion (diesel) engines, and combined-cycle plants, in addition to steam-electric plant information. Electric generating plants with a total combined capacity of 25 megawatts or greater purchased fossil fuels equivalent to 1.15 quadrillion Btu's in March, of which 96.2% was for steam-electric generation. Measured by their total heat content, fossil fuel purchases were up 15.7% from last month and down 25.6% from March 1977. Prices of the fuels are given and compared to charges of a year ago. Tables highlight the relative changes in deliveries and prices of fossil fuels for steam-electric generation for March 1977 and March 1978. (MCW)

4478 (DSD—95) **Legal and regulatory framework for the interface of a wood-fired power plant and the electric power grid in Vermont.** Berger, G.J. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Dec 1977. 22p. Resource Policy Center, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755.

The laws and regulations applicable to a wood-fired power plant in the State of Vermont are analyzed. Four hypothetical case studies, are used to illustrate the application of the law to specific types of generating facilities that might be built.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 4471, 4935, 4936

4479 (AD-A—062517) **Piti power plant intake survey, November 1977. Final report.** Grovhoug, J.G. (California Univ., Davis (USA). Dept. of Land, Air, and Water Resources). 15 Sep 1978. 65p. NTIS PC A04/MF A01.

A marine environmental field survey was conducted during November 1977 at Piti Power Plant, Guam, Marianas Islands. Descriptive data were obtained for benthic, nektonic and planktonic components of the resident ecosystem. Analysis of survey data consistently suggests that negligible environmental impact is directly attributable to the intake structure design and operation. The marine ecosystem adjacent to the Piti Plant supports a complex and diverse biotic assemblage. An examination of representative important species indicates that many taxa are provided with additional suitable habitat by the intake waterways and associated structures. Tabulations of data collected, checklists of organisms identified and detailed descriptions of marine environmental survey techniques used during the survey are presented in the text and appendices of the report.

4480 (NUS—3360) **Identification of hazards in non-nuclear power plants: phase II.** Fell, R.W. (NUS Corp., Rockville, MD (USA)). Aug 1979. 118p. California Energy Commission, 1111 Howe Avenue, Sacramento, CA 95825.

Electric generating stations can impose on and expose the general public and environment to adverse demands and emissions that may be considered detrimental or degrading. For example, a conventional coal fired plant demands coal as its fuel which, in turn, creates a demand for coal mining and coal transportation systems that may degrade the environment. In addition, the emissions from the coal plant (sulfur dioxide, ash, and other waste products), if not managed and controlled properly, might lead to a diminution in public health. These environmental and public hazards have been qualitatively ranked for a modern conventional coal fired power plant in the Phase I study report dated January 1978. This Phase II study extends the Phase I study to also include a hazards evaluation for two new emerging coal power plant technologies: coal-fired atmospheric fluidized bed (AFB) and pressurized fluidized bed combined-cycle (PFBCC) power generating systems, and considers the sensitivity of the hazards ranking for all the non-nuclear, i.e. coal-fired, oil-fired, and geothermal, power plants to the effects of population density, mode of plant operation, technical changes, location and environmental (temperature) effects.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 3958, 3969, 4008

4481 (PB—290200) **Feasibility of producing and marketing by-product gypsum from SO_2 emission control at fossil-fuel-fired power plants. Final report March 1976-March 1978.** Ransom, J.M.; Torstrick, R.L.; Tomlinson, S.V. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Oct 1978. 259p. NTIS PC A12/MF A01.

The report gives results of a study to identify fossil-fuel-fired power plants that might, in competition with existing crude gypsum sources and other power plants, lower the cost of compliance with SO2 regulations by producing and marketing abatement gypsum. In the Eastern U.S., gypsum production has a limited but important potential to lower the cost of compliance by power plants. Gypsum consumption was projected as 2 million tons in wallboard use and 3 million tons in cement, and total 1978 sales were estimated at $124.4 million in the Eastern U.S. Potential gypsum production by 113 Eastern U.S. steam plants requiring flue gas desulfurization for compliance amounts to 27 million tons. For about 90% of the potential abatement gypsum production, the cost difference between producing gypsum and conventional sulfite sludge by limestone scrubbing is greater than the estimated cost of mining natural gypsum. However, 30 power plants (generally <200 MW) with small annual outputs were identified that could reduce compliance cost by producing and marketing abatement gypsum. The 30 plants would replace 2.23 million tons of crude gypsum at 93 demand points (92 cement plants and 1 wallboard plant). Of the gypsum replaced, 74% is imported. First-year saving to steam plants is $11 million, and about $2 million is saved by the gypsum industry.

4482 (PB—290437) **Feasibility of installing sulfur dioxide scrubbers on stationary sources in the south coast air basin of California. Volume II: technical discussion. Final report.** Leo, P.P.; Rossoff, J. (Aerospace Corp., El Segundo, CA (USA)). Aug 1978. Contract ARB-A6-211-30. 267p. NTIS PC A12/MF A01.

The feasibility and costs of flue gas scrubbing to remove sulfur dioxide were determined for selected oil-fired power plants and industrial sources of SO_2 (including flue gas from fluid catalytic cracking units, coke calcining kilns and sulfuric acid plants) in the Los Angeles area. The objective was to achieve a 90 percent reduction in SO_2 emissions from each facility. Technical feasibility for SO_2 removal was established on the basis of the lime-limestone nonregenerable scrubber technology demonstrated in Japan and on units currently being installed and operated in the United States. Other factors such as compatibility with facility operations, space requirements, waste handling, and disposal were examined. Power, water, and flue gas reheating requirements were also addressed. It was concluded that all of the sites studied can be retrofitted with wet

nonregenerable scrubbers capable of removing SO_2 to the levels specified. The degree of difficulty of the scrubber installations varied considerably. Disposal of scrubber wastes produced from the scrubbers does not appear to present a significant handling problem or impact on existing Class I landfill disposal sites in Los Angeles County. Annualized charges in terms of mills per kilowatt hour, dollars per ton SO_2 removed, and dollars per ton product, as appropriate, are reported.

4483 (PB—292646) **University of washington electrostatic scrubber tests at a coal-fired power plant. Final report, June 1977-October 1978.** Pilat, M.J.; Raemhild, G.A. (Washington Univ., Seattle (USA). Dept. of Civil Engineering). Dec 1978. 59p. NTIS PC A04/MF A01.

The report gives results of tests of a 1700 cu m/hr University of Washington Electrostatic Spray Scrubber pilot plant on a coal-fired boiler to demonstrate its effectiveness for controlling fine particle emissions. The multiple-pass, portable pilot plant combines oppositely charged aerosol particles and water droplets in two water spray towers. Aerosol negative-charging sections precede each spray tower. The scrubber was tested in two modes: two-stage, including two active particle charging corona sections and two spray towers; and single-stage, including only one corona section and one spray tower. Simultaneous inlet and outlet source tests provided both size-dependent and overall mass basis particle collection efficiency information. Measured overall particle collection efficiencies ranged from 99.30 to 99.99%, depending on scrubber operating conditions, inlet particle size distribution, and mass concentration. Particle mass concentrations measured at the scrubber outlet ranged from 0.00041 to 0.0027 g/cu m. The average overall particle collection efficiency for all tests performed in the two-stage mode was 99.93%; single-stage average efficiency was 99.83%.

4484 (PB—293502) **Typical costs for electric energy generation and environmental controls. Final report. April-November 1978.** Klett, M.G. (Gilbert Associates, Inc., Reading, PA (USA)). Jan 1979. Contract EPA-68-02-2605. 30p. NTIS PC A03/MF A01.

The report gives typical costs for electric power generating plants and their environmental controls for installations of 1000 and 5000 MWe capacity, including the expected range of uncertainty. Total annualized costs for a particular configuration can be computed by adding the appropriate incremental costs for fuel and environmental control equipment to the cost of the base generation system. Fixed charges are computed on the basis of 18% of the capital investment; cost data are corrected to mid-1975. Two examples of the use of the data are included. The data and method are intended to provide an overview. Actual installation costs may differ widely from those found from information in this report because of site-specific considerations.

4485 (PB—295040) **Trace elements of fly ash: emissions from coal-fired steam plants equipped with hot-side and cold-side electrostatic precipitators for particulate control. Final report.** Mann, R.M.; Magee, R.A.; Collins, R.V.; Fuchs, M.R.; Mesich, F.G. (Radian Corp., Austin, TX (USA)). Dec 1978. Contract EPA-68-01-3702. 163p. NTIS PC A08/MF A01.

This report describes the results of a sampling and chemical analysis study of emissions from two coal-fired steam plants equipped with electrostatic precipitators for particulate control. The program objective was to define both emission and enrichment of trace elements in the flue gas exiting electrostatic precipitators operated at different process temperatures. Fly ash collected from the stack using cyclones and cascade impactors was analyzed to define trace element concentration of individual size fractions. Trace element enrichment of ash fractions was compared with an enrichment model to define the dependence of enrichment on particle size. Samples of the feed coal at each station were subjected to density separation to determine the association of each element with mineral (ash) and organic (ash-free) phases of the coal. The 15 elements included in the coal and ash studies are: arsenic, beryllium, cadmium, calcium, chromium, copper, fluorine, lead, manganese, mercury, nickel, selenium, titanium, uranium, and zinc.

POWER TRANSMISSION AND DISTRIBUTION

4486 (LA-UR—79-2845) **Superconducting magnetic energy storage applications and benefits for electric utility power systems.** Turner, R.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791069—2). Dep. NTIS, PC A02/MF A01.

From 6. annual conference on energy; Rolla, MO, USA (16 Oct 1979).

Large SMES units are being studied for electric utility applications as diurnal, load-curve leveling and as transient stabilizer units. Such SMES units show promise of providing greater operating flexibility than pumped-hydro or other types of energy storage. This operating flexibility, together with its fast response capability to provide transient and dynamic stabilization benefits to a power system, are discussed. Small SMES units are being designed for dynamic stability applications on electric power systems for use when negatively damped system operating conditions are encountered. The 30-MJ, 10-MW SMES dynamic-stabilizer design is presented; and the status of the component development and fabrication contracts which have been placed with commercial manufacturers is discussed.

AC SYSTEMS, EHV AND UHV

4487 (PB—294959) **Electric and magnetic field effects from 500-kV transmission lines.** Reilly, J.P. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Jan 1979. 125p. NTIS PC A06/MF A01.

Electric and magnetic field effects from 500-kV transmission lines have been analyzed. Topics studied include induction on rain gutters, fences and large vehicles, factors affecting realistic predictions, and short term effects on people. Results can be generalized to other voltage classes.

DC SYSTEMS

4488 (PB—295096) **Stability analysis of a three terminal high voltage direct current power transmission system.** Teles, J.E.; Carroll, D.P. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). May 1975. 140p. NTIS PC A07/MF A01.

The objective of this project was to investigate how individual system parameters affect the operation and stability of a three terminal HVDC (high voltage direct current) power system. In order to obtain the desired information, system stability boundary lines were plotted in parameter space. Consideration was given to the various operating control modes that a three terminal system may attain. A simplified model was developed for the analysis. This model was of a general nature, allowing each converter to operate in any one of the three common modes of operation. Analysis of the model generated a tenth order characteristic equation. This equation was implemented in a digital computer program to obtain stability boundaries and relative stability plots in parameter space. At that point it was possible to study the system and how various parameters affect the dynamic behavior of the network. Some of the parameters investigated were length of transmission line, commutating reactance, converter control parameters and the DC series reactance. Studies were made for normal overhead transmission and underground cable transmission. Since the model developed is of a general nature, it is possible to simulate all of the common control modes.

4489 (PNL—3121) **Proceedings of the workshop on electrical and biological effects related to HVDC transmission.** Bracken, T.D. (ed.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 209p. Dep. NTIS, PC A10/MF A01.

Six papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

4490 (PNL—3121, pp 1.1-1.38) **HVDC transmission line environment.** Bracken, T.D. (Bonneville Power Administration, Vancouver, WA). Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

The environment near HVDC transmission lines is discussed with emphasis on the electrical parameters of interest for biological effects research. The complex and dynamic nature of the electrical environment is demonstrated by measurements made under the BPA The Dalles +- 600 kV D-C Test Line. Prediction methods for the primary electrical parameters are discussed conceptually. Electrical and other effects which are of less significance biologically are also identified. Topics for future investigation are suggested.

4491 (PNL—3121, pp 2.1-2.34) **Characterization of the electric environment under HVDC transmission lines: instrumentation and measurement techniques.** Kotter, F.R. (National Bureau of Standards, Washington, DC). Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

Atmospheric research literature is reviewed in order to evaluate the applicability of equipment and measuring techniques used in that field to research on the electric environment near HVDC transmission lines. Measurements of electric fields, ion current density, conductivity of air, polar charge density, and net charge density are discussed. It is concluded that some estension of ranges, improvements in accuracy and better protection from perturbing influences will be required for the transmission line research measurements. (LCL)

4492 (PNL—3121, pp 3.1-3.29) **Biological effects of static electric fields and air ions in relation to dc power transmission.** Sheppard, A.R. (J.L. Pettis Memorial Veterans Hospital, Loma Linda, CA). Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

Research in the US and USSR on the biological effects on animals and humans of static electric fields and air ions produced by dc fields is reviewed. Results to date suggest a slight beneficial effect from high level negative ion concentrations, above 10^5 ions/cm^3 and defrimental effects from high levels of positive ions. However, to address environmental questions related to dc transmission lines, experiments combining air ions and electric fields must be considered, and these effects on large populations of animals must be measured. (LCL)

4493 (PNL—3121, pp 4.1-4.27) **Needs of utilities for information on biologic effects of HVDC transmission and the role of environmental studies.** Lee, J.M. Jr. (Bonneville Power Administration, Portland, OR). Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

Some of the important aspects of the topic of biologic effect for transmission lines in general and d-c transmission lines in specific are outlined. Some basic information needs pertaining to this topic from the viewpoint of an environmental specialist with a power marketing agency, and the basic approach in designing and conducting environmental studies of transmission lines are described.

4494 (PNL—3121, pp 5.1-5.27) **Animal housing design considerations in dc electric field bioeffects research.** Decker, J.R.; Kaune, W.T.; Gillis, M.F. (Pacific Northwest Lab., Richland, WA). Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

Complications arise in the design of animal exposure systems for the study of dc electric field effects which are not encountered in analogous studies with ac fields. The situation in the vicinity of dc transmission lines is complex and includes not only a static electric field (which varies slowly with weather conditions, particularly wind) but space charge, air ion currents to ground, a small static magnetic field, small alternating fields due to ripples in line voltage following ac-dc conversion, and perhaps corona-produced atmospheric species with potential for biological effects (e.g., oxides of nitrogen, ozone). Simulation of the dc transmission line environment in the laboratory can be accomplished only with considerable compromise. Furthermore, the presence of animal housing (and the animals themselves) will influence to some extent the distribution of space charge and air ion currents, as will fluctuations in relative humidity and air movement in the exposure volume. Requirements, problems and possible solutions to problems associated with the following four major areas of concern in system design are discussed: exposure parameters, environmental control, animal containment, and animal maintenance.

4495 (PNL—3121, pp 6.1-6.5) **Ongoing research related to HVDC transmission lines and effects.** Aug 1979.

In Proceedings of the workshop on electrical and biological effects related to HVDC transmission.

Comments by six individuals summarize current on-going studies by electric utilities and electric equipment manufacturers in the area of dc biological effects. (LCL)

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

4496 **10 m Nb_3Sn cable for 60 Hz power transmission.** Garber, M. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.;* **MAG-15**: No. 1, 155-158(Jan 1979).

A 10 m Nb_3Sn cable for 60 Hz power transmission has been constructed. The coaxial cable is of flexible, multiple helix, tape wound form. It has been designed and instrumented for short circuit current tests. The inner and outer conductor diameters are approximately 24 and 30 mm, respectively. The cable is installed in a horizontal cryostat with its ends fixed to room temperature supports. Measurements have been made of ac losses, fault currents, current sharing, and recovery from local quenches.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 4465, 4466, 4473

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 4507, 4527

4497 **New development in nondestructive measurement and verification of irradiated LWR fuels.** Lee, D.M.; Phillips, J.R.; Halbig, J.K.; Hsue, S.T.; Kaieda, K.; Medina, E.; Hatcher, C.R.; Caine, J.C. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 33(1979).

4498 **Three-dimensional free jets and wall jets: applications to heating and ventilation.** Sforza, P.M. (Polytechnic Inst. of New York, Farmingdale). pp 283-295 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An overview of the state-of-the-art of basic research in three-dimensional turbulent jet diffusion as it applies to engineering problems in heating and ventilation is presented. Two cases are treated in some detail: three-dimensional free jets and wall jets. The characteristics of such flows such as velocity decay, transverse growth, mean velocity fields, thermal effects, etc. are described. Emphasis is placed upon experimental results and empirical approaches for the prediction of such flow fields in practical applications.

4499 **Calculation of rotating airflows in spaces by conformal mapping.** Crommelin, R.D. (Environmental Hygiene TNO, Delft, Netherlands). pp 297-308 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A method has been developed to calculate 2-dimensional rotating air flows in rooms by conformal mapping. The agreement with the velocities measured in a test room and a scale model is in general good except at places where the influence of the air jet is strong. The velocities depend upon the air inlet velocity, the place of the air supply opening and the roughness of the walls.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 4497, 4507, 4519, 4521, 4524, 4526, 4527, 4529

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 4517, 4518, 4522, 4523, 4525

4500 (HEDL-TME—78-23) **Sodium vapor deposit technology.** Funk, C.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1979. Contract EY-76-C-14-2170. 93p. AT.

This report reviews available technology of sodium vapor deposits in sodium cooled reactors; describes operational problems attributed to such deposits; and discusses processes for deposit formation, removal, and prevention. The document presents data concerning the amount, appearance, condition, and effect of deposits on performance of Fast Flux Test Facility (FFTF) components exposed to high-temperature sodium vapor during testing. Components examined include various reactor plugs, the in-vessel handling machine, and the instrument tree.

4501 (ORNL/SUB—7463/1) **Simplified inelastic analyses using one-dimensional models.** Kamal, S.A.; Chern, J.M. (Foster Wheeler Energy Corp., Livingston, NJ (USA)). Sep 1979. Contract W-7405-ENG-26. 106p. AT.

A method of inelastic analysis using simplified structural models is investigated with special emphasis on the predictions of creep-fatigue damage and inelastic strain accumulation. The simplified models considered include the generalized plane strain, axisymmetric thick-walled cylinder which is applicable when the thermal loading in the actual structure is dominated by the through-the-wall temperature gradient, and the finite cylindrical shell which is appropriate when the meridional temperature gradient becomes dominant. From the thermal elastic analysis results of the detailed finite element model, the critical areas are identified, the dimensions of the simplified model selected, and the associated loading histograms derived. Inelastic analyses using efficient computer codes are then performed to simulate the stress-strain conditions of these critical areas. The method is applied to the primary inlet nozzle and Y-junction of the CRBRP-IHX for which detailed inelastic analysis results for unit load cycles are available for comparison. It is indicated in the first application that the generalized plane strain model is able to yield accurate and conservative predictions. In the

second application in which the cylindrical shell model is employed with specified displacement boundary conditions, the general trend of stress variation in a complete load cycle can be simulated and the fatigue predictions were conservative. However, it was found that the rapid stress relaxation tends to underestimate the creep damage and inelastic strain accumulations. The end-of-life creep damage prediction becomes conservative if the trend of cyclic change is taken into consideration; the inelastic strain prediction is persistently non-conservative by a range of 27 to 81%. A procedure to improve predictions that combines the force and displacement boundary conditions is outlined.

4502 (WARD-CR—94000-2) **Core restraint development. Quarterly progress report for period ending February 28, 1979.** Sirota, B.B. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract EY-76-C-02-3045-005. 58p. AT.

Processing of compaction data results from nominal and low friction tests on a straight 7 row core was continued. The 14 row straight core compaction (nested) and dislodged core tests were successfully completed. A numerical comparison of irradiation induced free bow shapes at three points in time indicate ANSYS deflections to be 4%, 17%, and 28% greater than the respective NUBOW-3D predictions; possible reasons for the differences are being probed. Efforts were continued to provide an analytical evaluation of mechanical effects parameters and assess their significance by comparisons with the mechanical effects resulting from 7 row testing in the Core Restraint Test Facility (CRTF). Effort was started on a benchmark problem set to be used for core restraint evaluation of irradiation creep and swelling equations. Study results of the FFTF benchmark experiment indicate that the test goals are feasible in the multi-duct fuel test assembly (MFTA).

4503 (WARD-HT—94000-2) **Plastic in-plane bending and buckling of an elbow: comparison of experimental and simplified analysis results.** Sobel, L.H.; Newman, S.Z. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Aug 1979. Contract AM02-76CH94000. 200p. AT.

This work shows that analytical predictions obtained from a large displacement MARC pipe-bend element 17 analysis are in reasonably good agreement with experimental results obtained in a companion room temperature test of a 16″ OD Type 304 stainless steel elbow, which was loaded by an in-plane closing bending moment in a step-wise fashion until buckling occurred. Estimates of the buckling load obtained from the Southwell Plot Method and a number of presently used arbitrary methods are compared with the experimental buckling load. It is found that the Southwell Method provides an accurate estimate of the buckling load provided that it is based on the nonlinear component of the deformation. The three arbitrary methods considered herein all have the shortcomings of being dependent on the linear elastic region of the moment-deformation curves, whereas the plastic buckling load is not strongly dependent on this region, if at all, and of being devoid of a sound theoretical basis.

4504 (WARD-NA—940002) **Physical characteristics of corrosion product deposits.** Miller, R.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Sep 1979. Contract AM02-76CH94000. 55p. AT.

Test objectives were to measure the flowrate required to remove deposits from a deposit bearing surface at 700°F and to characterize these sheared deposits. The test technique involved filtering the sodium inventory of a loop, MTL-4 to establish a loop blank, i.e., the quantity of particulates entrained in the sodium. Next, a deposit bearing specimen and filter were installed in MTL-4. Thereafter, the flowrate past the deposit surface was increased in sequential steps with a new filter installed at each test velocity. Comparison of the deposit weights, obtained from the loop blank and test velocity filters, yielded a possible shear velocity for deposit removal. Also the metallic composition and morphology of the filtered debris were determined.

REGULATION AND LICENSING

4505 (RDT-F—8-6T(7-79)(Amendment)) **Hoisting and rigging of critical components and related equipment. Amendment 5, July 1979.** Burchsted, C.A. (Oak Ridge National Lab., TN (USA)). 26 Nov 1979. Contract W-7405-ENG-26. 1p. RSO.

ECONOMICS

4506 (SERI/TP—51-177) **Advanced technology and public policy: the development of the nuclear power reactor in six nations.** deLeon, P. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 38p. Dep. NTIS, PC A03/MF A01.

An analysis of how political, social, and economic forces shaped the development of nuclear power in the US, USSR, Great Britain, France, Canada, and West Germany is presented.

FUEL CYCLE

4507 (DOE/ER/10020—T1) **Historical survey of nuclear fuel utilization in the US LWR power plants. Final report.** Turner, S.E.; Elgin, W.J.; Hancock, R.P. (Southern Science Applications, Inc., Dunedin, FL (USA)). Aug 1979. Contract AC01-79ER10020. 64p. (SSA—122). Dep. NTIS, PC A04/MF A01.

The present study was performed for the US Department of Energy, under Contract DE-AC-01-79ER10020, for the purpose of describing and assessing US experience in fuel burnup and resource utilization over the past 16 years of light water reactor (LWR) power plant operation. The assessment is based on actual spent-fuel-unloading historical data for 55 plants from 1962 through the end of 1978. In assessing these data, some particular data points were eliminated in order that the results might be more representative of zirconium clad UO_2 fuel assemblies typical of modern LWR technology.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 3964, 4709

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

4508 (LA—8057-PR) **Transport and reactor theory. Progress report, April 1-June 30, 1979.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 63p. Dep. NTIS, PC A04/MF A01.

Research and development progress in transport and reactor theory by the Los Alamos Scientific Laboratory's Group T-1 for the third quarter of FY 79 is reported. Included are tasks in the areas of Transport Methods Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, Shielding Methods, Safeguards Analysis, and Fission Reactor Neutronics.

4509 (LA-UR—79-2897) **ENDF/B-IV, and V cross section libraries for thermal power reactor analysis.** MacFarlane, R.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791058—17). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The NJOY processing system was used to produce thermal reactor cross-section libraries from ENDF/B-IV, and -V evaluations for the fuel cycle codes EPRI-CELL and EPRI-CPM, for the continuous-energy Monte Carlo code MCNP, and for the Los Alamos discrete-ordinates transport codes. This consistent data source allowed the approximate methods (equivalence theory, B_1, integral transport, P/sub L/-S/sub N/) to be compared with accurate Monte Carlo results. So far, this has resulted in improved methods for space-and-energy self-shielding in the resonance range (e.g., the NJOY flux calculator, epithermal disadvantage factors for EPRI-CELL, shielded elastic removal), it has shown why the newest ENDF-based libraries initially gave results worse than the old libraries, and it has pointed out problems for future study such as resonance interference effects at high burnup. Finally, the results are compared to various criticality benchmarks to evaluate the performance of ENDF/B-V for thermal reactor analysis and to establish the biases introduced by the approximate methods used in the fuel cycle codes. 3 tables.

4510 (WAPD-TM—1451) **Critical heat flux tests with high pressure water in an internally heated annulus with alternating axial heat flux distribution.** Beus, S.G.; Humphreys, D.A. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1979. Contract EY-76-C-11-0014. 30p. Dep. NTIS, PC A03/MF A01.

Critical heat flux experiments were performed with an alternating heat flux profile in an internally heated annulus. The heated length was 84 inches with a square wave alternating heat flux profile over the last 12 inches having a maximum-to-average heat flux ratio of 1.76. Test data were obtained at pressures from 800 to 2000 psia, mass velocities from 0.25×10^6 to 2.8×10^6 lb/hr-ft^2 and inlet temperatures ranging from 400 to 600°F. Two different electrically heated test sections were employed both with 72 inch uniform and 12 inch alternating heat flux sections. The second test section had a 0.44 inch hot patch with a peak-to-average heat flux ratio of 2.7 superimposed on the alternating flux profile at the exit end. Critical heat flux results with the alternating heat flux profile and with the

superimposed hot patch were shown to be equivalent to those obtained in previous tests with a uniform heat flux profile except for several data points at low mass velocity and high enthalpy for which there is an apparent experimental bias in the uniform heat flux results.

COMPONENTS AND ACCESSORIES

4511 (PB—294319) **Ice blockage of water intakes. Technical report.** Carey, K.L. (Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Mar 1979. Contract NRC-03-78-153. 31p. NTIS PC A03/MF A01.

The ice blockage of water intake structures can pose serious threats to the availability of cooling water at thermal power plants. Using information gained from a literature search and general knowledge of the problem, ice blockage difficulties are described as they may occur in rivers, lakes, reservoirs, and estuaries, and as they may affect intakes either at the surface or submerged. To further enable understanding of these problems, characteristics of both surface sheet ice and frazil ice are examined, namely, formational processes, sizes, thickness, movement or mobility, and modes of blockage or adhesion. Case histories of incidents of ice blockage of intakes, particularly of nuclear power plant cooling systems, are given by means of excerpts from the technical literature. Lastly, a brief overview is provided on the matter of solving ice blockage problems, either through original design, post-construction modification, or revised operational techniques.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 4937

SITING

REFER ALSO TO CITATION(S) 4887

RADIOACTIVE EFFLUENTS

4512 (NUREG/CR—0789) **Evaluation of empirical atmospheric diffusion data.** Horst, T.W.; Doran, J.C.; Nickola, P.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 151p. (PNL—2599). Dep. NTIS, PC A08/MF A01.

A study has been made of atmospheric diffusion over level, homogeneous terrain of contaminants released from non-buoyant point sources up to 100 m in height. Current theories of diffusion are compared to empirical diffusion data, and specific dispersion estimation techniques are recommended which can be implemented with the on-site meteorological instrumentation required by the Nuclear Regulatory Commission. A comparison of both the recommended diffusion model and the NRC diffusion model with the empirical data demonstrates that the predictions of the recommended model have both smaller scatter and less bias, particularly for groundlevel sources.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 4934

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 4500, 4756

4513 (CONF-791124—3) **Overview of LOFT instrumentation.** Bixby, W.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 33p. Dep. NTIS, PC A03/MF A01.

From GRS-Fachgesprach; Munich, F.R. Germany (30 Nov 1979).

A description of instrumentation used in the Loss-of-Fluid Test (LOFT) large break Loss-of-Coolant Experiments is presented. Emphasis is placed on hydraulic and thermal measurements in the primary system piping and components, reactor vessel, and pressure suppression system. In addition, instrumentation which is being considered for measurement of phenomena during future small break testing is discussed.

4514 **Evaluation of reactor track-etch power monitor.** Carpenter, B.S. (National Bureau of Standards, Washington, DC); Pilione, L.J.; Schroder, I.G.; Roe, J.W.; Sanatini, S. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 21-22(1979).

4515 **Integrated quality status and inventory tracking system for fast flux test facility driver fuel pins.** Gottschalk, G.P. (Westinghouse Electric Corp., Richland, WA). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 7, 26-27(1979).

4516 **In situ verification techniques for fast critical assembly cores.** Brumbach, S.B. (Argonne National Lab., IL); Roche, C.T.; Amundson, P.I. *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 31-32(1979).

REACTOR SAFETY

4517 (ANL-AFP—59) **Advanced fuels development program. Quarterly progress report, July-September 1978.** Kittel, J.H. (comp.). (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 216p. AT.

Progress is summarized in the following mixed carbide and mixed nitride LMFBR fuel development tasks: steady-state irradiation performance, transient irradiation performance, fabrication, design and modeling, fuels properties, and safety.

4518 (ANL-RDP—84) **Reactor development program. Progress report.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 182p. AT.

This progress report summarizes the Argonne National Laboratory work performed for the Reactor Development Program during June 1979 in the following research and development areas: Safety, Engineered Systems and Components, Physics, Gas Cooled Breeder Reactor, and Test Facilities - ANL.

4519 (CONF-791123—2) **RELAP4/MOD6 assessment.** Charlton, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 20p. Dep. NTIS, PC A02/MF A01.

From Water reactor safety meeting; Washington, DC, USA (5 Nov 1979).

The use of RELAP4/MOD6 computer program for analyzing loss-of-coolant accident conditions in PWR type reactors is described.

4520 (CONF-791124—2) **Analysis of LOFT Tests L2-2, L2-3 and L3-0.** Leach, L.P. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 36p. Dep. NTIS, PC A03/MF A01.

From GRS-Fachgesprach; Munich, F.R. Germany (30 Nov 1979).

This paper describes LOFT Tests L2-2, L2-3, and L3-0 and presents conclusions reached from analysis of these tests. The LOFT L2 series of tests, called the power ascension series, originally consisted of six tests. The first four tests, L2-1 through L2-4, were identical except for step-wise increases in core power for each test. Comparison of these tests, and the nonnuclear Test L1-5, was planned to evaluate the effect of core power on system and ECC behavior during large cold leg break LOCA's. Tests L2-5 and L2-6 were to provide parametric investigations of the effect of loss of offsite power and prepressurized fuel. Prior to the start of the L2 series, it was decided Test L2-1 was not necessary due to the information learned from the LOFT nonnuclear tests and PBF lead rod tests. Tests L2-2 and L2-3 are described. The posttest analysis of Tests L2-2 and L2-3 is discussed, and conclusions reached from the comparisons of the experimental data to computer calculations presented. In addition, the results and implications of computer calculations on a commercial size PWR with the same model used for LOFT are presented. Finally, Test L3-0 is described and conclusions reached from it introduced.

4521 (DP-MS—79-83) **WRAP-PWR-EM system development and applications.** Beranek, F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 18p. (CONF-791123—1). Dep. NTIS, PC A02/MF A01.

From Water reactor safety meeting; Washington, DC, USA (5 Nov 1979).

The WRAP-EM system is a complete computational system for analysis of loss-of-coolant accidents (LOCAs) in light-water power reactors. The system has been developed for use by the Nuclear Regulatory Commission in evaluating and interpreting reactor vendor model methods and results. WRAP-PWR-EM is the integrated system of codes used for the analysis of pressurized water reactors (PWRs) GAPCON-THERMAL-2 is used to initialize fuel parameters as a function of reactor operating time. Both the blowdown and reflood phases of an accident are analyzed by RELAP4/MOD5. The refill calculation is based on a simple accumulator flow model (FLOW4) developed at NRC, and the hot-pin analysis is performed by FRAP-T4-LACE. The automated transfer of relevant data from one code to another is accomplished through interface routines developed at SRL (except RELAP4/MOD5-FLOOD to FRAP).

4522 (ESG-DOE—13285) **CRBRP sodium fire tests. Technical progress report, May-June 1979.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 15 Oct 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

Progress in small-scale fire suppression tests and spray maximization tests related to sodium fires in the Clinch River Breeder Reactor is reported.

4523 (HEDL-SA—1665) **Attenuation of airborne debris from LMFBR accidents.** Morewitz, H.A.; Johnson, R.P.; Nelson, C.T.; Vaughan, E.U.; Guderjahn, C.A.; Hilliard, R.K.; McCormack, J.D.; Postma, A.K. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Hanford Engineering Development Lab., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 15p. (CONF-781022—128). Dep. NTIS, PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Experimental and theoretical studies have been performed to characterize the behavior of airborne particulates (aerosols) expected to be produced by hypothetical core disassembly accidents (HCDA's) in liquid metal fast breeder reactors (LMFBR's). These aerosol studies include work on aerosol transport in a 20-m high, 850-m^3 closed vessel at moderate concentrations; aerosol transport in a small vessel under conditions of high concentration (~ 1000 g/m^3), high turbulence, and high temperature (~ 2000°C); and aerosol transport through various leak paths. These studies have shown that little, if any, airborne debris from LMFBR HCDA's would reach the atmosphere exterior to an intact reactor containment building.

4524 (NUREG/CR—0954) **Blowdown heat transfer separate-effects program. Quarterly progress report, April-June 1979.** White, J.D.; Anklam, T.M.; Bohanan, R.E. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 21p. (ORNL/NUREG/TM—345). Dep. NTIS, PC A02/MF A01.

Information is presented concerning operating procedures and results for the Forced Convection Test Facility and Thermal-Hydraulic Test Facility; two-phase instrument development; bundle fabrication and assembly; and heater procurement and evaluation.

4525 (NUREG/CR—1027) **Disassembly phase energetics: an examination of the impact of SIMMER models and assumptions.** Henninger, R.J.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract W-7405-ENG-36. 57p. (LA—7998-MS). Dep. NTIS, PC A04/MF A01.

We present an assessment of several aspects of material motion as predicted by the SIMMER code during the disassembly and early transition phase of an unprotected loss of flow transient in a liquid metal cooled advanced reactor. We divide the study into the fuel expansion phase of an energetic dissassembly and into the early fuel motion stage of subassembly scale pin disruption under the forces of fission gas dispersal and sodium vapor flow. In the expansion phase we concentrate mainly on assessing the SIMMER estimates of energy partitioning of the expanding fuel bubble through the upper core and internal structures which may typically be present. Comparison with simple models leads us to conclude that the SIMMER formulation predicts a reasonable energy partition when heat transfer is not taken into account. The modeling of heat transfer is so complex that no general statement about the physical realizability of the SIMMER predicted energy partition due to the effect can now be made. This is particularly true when fuel to sodium heat transfer is assumed. We compared the subassembly scale early fuel motion with that given by the SLUMPY module in the SAS3A code. We find that SLUMPY may greatly overpredict the extent and magnitude of fuel motion in the time scales involved under LOF conditions using the nominal SLUMPY parameters.

4526 (NUREG/CR—1059) **TRAC-P1A developmental assessment.** Vigil, J.C.; Williams, K.A. (comp.). (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 183p. (LA—8056-MS). Dep. NTIS, PC A09/MF A01.

The Transient Reactor Analysis Code (TRAC) is being developed at the Los Alamos Scientific Laboratory (LASL) to provide an advanced best-estimate predictive capability for the analysis of postulated accidents in light water reactors. TRAC-P1A provides this analysis capability for pressurized water reactors and for a wide variety of thermal-hydraulic experimental facilities. It features a three-dimensional treatment of the pressure vessel and associated internals; two-phase nonequilibrium hydrodynamics models; flow-regime-dependent constitutive equation treatment; reflood tracking capability for both bottom flood and falling film quench fronts; and consistent treatment of entire accident sequences including the generation of consistent initial conditions. This report presents the results of initial developmental assessment calculations performed with TRAC-P1A prior to its public release. These calculations were performed with the same code version and include separate-effects experiments for the blowdown, refill, and reflood phases of a loss-of-coolant accident (LOCA); systems-effects experiments for the blowdown phase; and an integral-effects experiment for the blowdown/refill portion of a LOCA. Although the initial set of assessment calculations is not exhaustive, results obtained thus far are encouraging. Additional assessment of the code is in progress through predictions and analyses of other experiments.

4527 (SAND—79-1918C) **Melt/concrete interactions: the Sandia experimental program, model development, and code comparison test.** Powers, D.A.; Muir, J.F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 50p. (CONF-791118—3). Dep. NTIS, PC A03/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

High temperature melt/concrete interactions have been studied both experimentally and analytically at Sandia under sponsorship of Reactor Safety Research of the US Nuclear Regulatory Commission. The purpose of these studies has been to develop an understanding of these interactions suitable for risk assessment. Results of the experimental program are summarized and a computer model of melt/concrete interactions is described. A melt/concrete interaction test that will allow this and other models of the interaction to be compared is also described.

4528 (UCRL—15110) **Seismic Safety Margins Research Program (Phase I). Project I. Plant/site selection, plant/site selection assessment report.** Reed, R.L. (Engineering Decision Analysis Co., Palo Alto, CA (USA)). 20 Jul 1979. Contract W-7405-ENG-48. 60p. (EDAC—175-090.01). Dep. NTIS, PC A04/MF A01.

Lawrence Livermore Laboratory (LLL) is conducting research on the seismic risk of nuclear power plants through the Seismic Safety Margins Research Program (SSMRP). Phase I of the SSMRP will include a study of an existing plant and site. Results are presented of a study of existing and planned nuclear power plants in the United States. Selection criteria were developed and a recommendation for a specific plant for the SSMRP Phase I effort is given. Power plant characteristics including types of nuclear steam supply steam, containment structure, electric power capacity, geographic location, site seismicity, and foundation soil properties were evaluated.

4529 (UCRL—52855) **Measurements and calculations of water velocity, momentum flux, and related flow parameters obtained from single-phase water integral acceptance tests of the PKL instrumented spool pieces.** Stein, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Oct 1979. Contract W-7405-ENG-48. 117p. Dep. NTIS, PC A06/MF A01.

The operation of the emergency core cooling system and its related steam-binding problems in pressurized water reactors is the subject of a cooperative study by the United States, Germany, and Japan. Lawrence Livermore Laboratory and EG & G, Inc., San Ramon Operations, are responsible for the design, hardware, and software of the 80.8-mm and 113-mm spool piece measurement systems for the German Primarkreislauf (PKL) Test Facility at Kraftwerk Union in Erlangen, West Germany. This work was done for the US Nuclear Regulatory Commission, Division of Reactor Safety Research, under its 3-D Technical Support and Instrumentation Program. Four instrumented spools capable of measuring individual phase parameters in two-phase flows were constructed. Each spool contains a flow turbine, drag screen, three-beam densitometer, and pressure and temperature probes. A computerized data acquisition system is also provided to store and analyze data from the four spools. The four spools were shipped to the PKL Test Facility in West Germany for acceptance testing in a water-flow loop. Spool measurements of velocity and momentum flux were compared to the values obtained from an orifice meter installed in the loop piping system. The turbine flowmeter velocity data for all tests were within allowable tolerances. Drag screen momentum flux measurements were also within tolerance with the exception of a few points.

ENERGY STORAGE

4530 (ANL/CES/TE—79-8) **Fuel storage systems.** Donakowski, T.D.; Tison, R.R. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 79p. Dep. NTIS, PC A05/MF A01.

Storage technologies are characterized for solid, liquid, and gaseous fuels. Emphasis is placed on storage methods applicable to Integrated Community Energy Systems based on coal. Items discussed here include standard practice, materials and energy losses, environmental effects, operating requirements, maintenance and reliability, and cost considerations. All storage systems were found to be well-developed and to represent mature technologies; an exception may exist for low-Btu gas storage, which could have materials incompatability.

MAGNETIC

REFER ALSO TO CITATION(S) 4486

4531 (LA—7885-MS(Vol.7)) **1-GWh diurnal load-leveling superconducting magnetic energy storage system reference design. Appendix F. 1-GWh electrical system design.** Boenig, H.J. (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract W-7405-ENG-36. 22p. Dep. NTIS, PC A02/MF A01.

Two circuit configurations for reducing the installed converter power and cost of high-power converter systems that operate in a constant-power mode over a wide current and voltage range are suggested and analyzed.

4532 (LA-UR—79-2775) **1-GWh diurnal load-leveling superconducting magnetic energy storage system reference design.** Hassenzahl, W.V.; Rogers, J.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 17p. (CONF-791075—1). Dep. NTIS, PC A02/MF A01.

From International symposium on superconductive energy storage; Osaka, Japan (8 Oct 1979).

A point reference design has been completed for a 1-GWh Superconducting Magnetic Energy Storage system. The system is for electric utility dirunal load leveling; however, such a device will function to meet much faster power demands including dynamic stabilization. The study has explored several concepts of design not previously considered in the same detail as treated here. Because the study is for a point design, optimization in all respects is not complete. The study examines aspects of the coil design; superconductor supported off of the dewar shell; the dewar shell, its configuration and stresses; the underground excavation and related construction for holding the superconducting coil and its dewar; the helium refrigeration system; the electrical converter system; the vacuum system; the guard coil; and the costs. The report is a condensation of the more comprehensive study which is in the process of being printed.

COMPRESSED GAS

REFER ALSO TO CITATION(S) 4539

4533 (PNL—3047) **Numerical analysis of temperature and flow effects in a dry, two-dimensional, porous-media reservoir used for compressed air energy storage.** Wiles, L.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 87p. Dep. NTIS, PC A05/MF A01.

The purpose of the work is to define the hydrodynamic and thermodynamic response of a CAES dry porous media reservoir subjected to simulated air mass cycling. The knowledge gained will provide, or will assist in providing, design guidelines for the efficient and stable operation of the air storage reservoir. The analysis and results obtained by two-dimensional modeling of dry reservoirs are presented. While the fluid/thermal response of the underground system is dependent on many parameters, the two-dimensional model was applied only to those parameters that entered the analysis by virtue of inclusion of the vertical dimension. In particular, the parameters or responses that were quantified or characterized include wellbore heat transfer, heat losses to the vertical boundaries of the porous zone, gravitationally induced flows, producing length of the wellbore, and the effects of nonuniform permeability. The analysis of the wellbore heat transfer included consideration of insulation, preheating (bubble development with heated air), and air mass flow rate.

4534 (PNL-SA—7910) **Two-dimensional fluid and thermal analysis of dry porous rock reservoirs for CAES.** Wiles, L.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 8p. Dep. NTIS, PC A02/MF A01.

The analysis of the hydrodynamic and thermodynamic response of a Compressed Air Energy Storage (CAES) dry porous media reservoir subjected to daily air mass cycling is described. The analysis is based upon a numerical computer model that uses a finite difference method to solve the two-dimensional (r-z) conservation equations for the transport of mass, momentum, and energy in the below ground system. The investigation quantifies the behavior of those parameters that enter the model by virtue of inclusion of the vertical dimension. The topics that were evaluated were the wellbore heat transfer and the pressure and temperature response of the reservoir. The wellbore heat transfer was evaluated with respect to insulation, preheating (bubble development with heated air), and air mass flow rate. The wellbore heat transfer reduces thermal energy recovery while offering the advantage that the temperatures and thermal cycling at the reservoir were reduced. The most severe thermal cycling occurred in the wellbore near the earth's surface. The pressure and temperature responses of the reservoir were found to be largely dependent on the producing length of the wellbore within the porous zone. Reduced producing lengths resulted in increased reservoir pressure losses as well as nonuniform temperature distributions. Other reservoir parameters that were evaluated that had less significant effects were anisotropic permeability and stratified permeability, heat losses to the vertical boundaries, and natural circulation.

FLYWHEELS

4535 (SAND—79-7007) **Application of magnetic suspensions and fluid film bearings to energy storage flywheels. Technical report.** Eusepi, M.; Martin, L.; Ray, A. (Mechanical Technology, Inc., Latham, NY (USA)). Mar 1979. Contract EY-76-C-04-0789. 168p. Dep. NTIS, PC A08/MF A01.

The result of the study presented is the design of a suspension system for the support of a 10 kWh energy storage flywheel, with scaling equations and curves suitable for extending the 10 kWh design to other flywheel sizes up to 100 kWh. Included in the study is the design of a test vehicle suitable for evaluating the final suspension design. The first phase of this effort was a concept study in which fluid film bearings for both radial and axial load support and magnet suspensions were examined in several combinations to determine suitability. The concept study is described and includes discussions on flywheel sizing, journal and thrust bearing sizing, magnetic suspension sizing and geometric arrangements.

4536 (SAND—79-7025) **Magnetic bearing support study for a 10 kW-hr energy storage flywheel.** Eusepi, M.W.; Wilcock, D.F. (Mechanical Technology, Inc., Latham, NY (USA)). Nov 1979. Contract EY-76-C-04-0789. 180p. Dep. NTIS, PC A09/MF A01.

The design of a magnetic suspension system which fully supports a 10 kW-hr energy storage flywheel is presented. Included in the design presentation are discussions leading to the selection of the suspension type and the extension of the design to other storage levels ranging from a 1 kW-hr vehicular size to a large 100 kW-hr stationary system.

THERMAL

REFER ALSO TO CITATION(S) 4441, 4442, 4657

4537 (BMVg-FBWT—79-12) **Latent heat storage devices. Part 1: properties and possible applications of latent heat storage devices.** Krichel, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Pfinztal (Germany, F.R.). Inst. fuer Chemie der Treib- und Explosivstoffe). 1979. 84p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

A special card-record system has been established that indicates the most significant physico-chemical data like melting point, specific enthalpy of fusion, crystallization kinetics, etc. of potential phase-change materials which have been reported in the literature since 1951. The best storage materials in the lower temperature range (- 30 to 100°C) are paraffins, salt-hydrates, clathrates, and their mixtures. In the medium temperature region (100 to 500°C) hydroxides and halides of light metals and their mixtures are most suitable. The best storage properties at high temperatures (> 500°C) show alkali- and alkaline earth-halides, especially -fluorides. Adaption of different latent heat capacitor designs to operational temperature and storage material, and the relation between heat transport, heat exchanger construction and type of crystallization are discussed. Possible failures caused by unfavorable crystallization kinetics (stratification, supercooling) and some measures to avoid such faults are described. Construction and insulation materials with special emphasis on corrosion and stability problems are reviewed. All data and members are presented in form of extented tables, if possible.

4538 (BMVg-FBWT—79-13) **Latent heat storage devices. Part 2: storage masses, constructional shapes and materials for melt heat storage devices.** Krichel, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Pfinztal (Germany, F.R.). Inst. fuer Chemie der Treib- und Explosivstoffe). 1979. 65p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

Latent heat storage systems make use of the enthalpies of phase changes to store thermal energy. The operational temperature depending on the phase change material remains constant at charge and discharge. Melting is the most appropriate phase change for heat storage due to considerable heat capacities and high densities of condensed phases. Because of the promising technical and operational advantages of latent heat storage the report deals with thermodynamic, kinetic and chemical properties of phase change materials. Eutectics and congruently melting compounds are the most useful substances among the potentially suitable latent heat storage materials. At present supercooling of many storage media is a considerable difficulty. Besides the treatment of economics, safety hazards and

environmental problems and the description of some practical applications, two suggestions for the military applicability of latent heat storage devices are discussed.

4539 (CONF-781231—, pp 267-268) **Packed beds for thermal energy storage in an underground compressed air energy storage system.** Hamilton, N.I. (Massachusetts Inst. of Tech., Lexington). 1979.

From 3. annual thermal energy storage contractor's information exchange meeting; Springfield, VA, USA (5 Dec 1978).

A preliminary design study of a 200-MW(e) packed bed thermal energy storage unit for operating in the range 1000°F to 1500°F is described. This storage unit is considered for use in both conventional and solar-augmented systems. Also included is a 100-MW(e) system, part of which is compressed air and thermal energy storage, and part of which is a separate solar source, that feeds directly into the turbine.

4540 Analytical and experimental determination of the temperature distribution in stratified hot water stores. Leyers, H.J.; Scholz, F.; Tholen, A. (Kernforschungsanlage, Julich GmbH, Germany). pp 683-693 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Stratified hot water storage offer the advantage that most of the stored heat can be extracted close to the loading temperature. In storage of this kind during load changing processes, a transition layer is built up which acts as a transient insulation barrier between hot and cold water. The development of this transition layer can be calculated assuming heat transfer by thermal conductivity only. But in reality the heat transfer through this transition layer will be also influenced by flow conditions of the load changing devices and natural convection. Therefore experiments were performed to investigate the real behavior of such storage. An existing well insulated square container (4.4 m x 4.7 m x 2 m high) was used. Comparisons between analytical and experimental results - so far available - indicate a good consistency only if a higher than the molecular thermal conductivity of water is assumed in the calculations. This effect seems to be due to increased heat transfer by natural convection.

CHEMICAL

4541 (SAND—78-8195) **Assessment of the use of chemical reaction systems in electric utility applications. Phase II. Final report, June 1979.** Chen, H.T.; Hsu, J.C.; Mounce, W.R.; Nankani, F.D. (Sandia Labs., Livermore, CA (USA)). Jun 1979. Contract EY-76-C-04-0789. 200p. Dep. NTIS, PC A09/MF A01.

The report documents the work performed during the second phase of an assessment of the use of chemical reaction systems (CRS) as a means to store or transport thermal energy. The Phase I study resulted in a catalogue of potential heat sources, end users, and a number of candidate chemical reaction systems. The Phase I study is documented in EPRI RP 1086-1. In the current Phase II study, technical and economic assessment of three CRSs were continued. The objectives were to estimate the life cycle cost of storing or transporting waste heat via these CRSs and to compare it with the cost of heat recovery via conventional technologies. This latter objective was approached by selection and design of a commercially available alternative system for each CRS, as a basis for evaluating attractiveness of CRS. It was found that none of the CRSs studied were economically competitive against a commercially available alternative system nor against fuels (natural gas and oil) at current prices. However, one of the CRSs has the potential for becoming economical in selected applications within the 1980 to 2000 period, should fuel costs escalate considerably above current levels. In general, CRS appears to have the best potential when coupled with a large, continuous heat source for transport applications within relatively short distances.

4542 (SAND—79-8208) **Thermochemical energy storage and transport program. Progress report, October 1977-December 1978.** Bramlette, T.T. (Sandia Labs., Livermore, CA (USA)). Sep 1979. Contract EY-76-C-04-0789. 109p. Dep. NTIS, PC A06/MF A01.

To exploit the potential advantages and quantify the disadvantages of thermochemical reactions for energy storage and transport applications, the program has been structured initially to explore a wide range of chemical reactions and applications. In general, the development procedure consists of: (1) identification and evaluation of preferred current and future users of reversible chemical reactions for energy storage and transport; (2) identification of specification requirements and evaluation of available technology and technology needs for selected storage and transport systems; (3) formulation and evaluation of energy storage and transport concepts which meet the requirements established above; (4) definition and development of the required technology; (5) comparison of thermochemical storage and transport concepts with competing technologies, and assessment of their conservation potential; and (6) development of the most promising concepts and systems to the point of demonstration on a scale commensurate with commercial application. Progress made during the reporting period is summarized. (TFD)

BATTERIES

DESIGN AND DEVELOPMENT

4543 (PB—293155) **Characterization of priority pollutants from a secondary lead and battery manufacturing facility. Final report.** Mezey, E.J. (Battelle Columbus Labs., OH (USA)). Jan 1979. Contract EPA-68-03-2552. 44p. NTIS PC A03/MF A01.

A plant site at which secondary lead is produced from old batteries was sampled utilizing the U.S. EPA protocol for the priority pollutants. The waste treatment plant at this site uses lime and settle techniques to remove pollutants from the wastewater before it is discharged into a stream. The results of the study show that the concentration of benzene and cyanides were below their detection limits in all of the streams sampled. Further, the concentrations of phenols were below their detection limit in both the influent and effluent of the treatment plant. The results of the study also show that the lime and settle treatment practiced at this site removes in excess of 90 percent of the lead, mercury, and zinc. The technique is slightly less effective for copper and cadmium because of their low concentrations in the influent to the treatment plant. Nevertheless, in excess of 70 percent of both copper and cadmium was removed. Because of the extremely low concentrations of antimony, chromium, and nickel in the influent to the treatment plant, the effectiveness of the lime and settle treatment for the removal of these metals could not be evaluated with any degree of confidence.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 4787

4544 (AD-A—062150) **Diffusion studies on a PPQ-CA membrane - a comparison with standard membrane materials.** Kilroy, W.P.; Laughlin, L. (Naval Surface Weapons Center, Silver Spring, MD (USA)). 4 Dec 1978. 23p. NTIS PC A02/MF A01.

This report discusses zincate and electrolyte diffusion through a new separator material currently being developed for potential use in alkaline AgO-Zn batteries.

4545 (AD-A—062498) **On the selection of electrolytes for high-energy-density storage batteries.** Klochko, M.A.; Casey, E.J. (Defence Research Establishment, Ottawa, Ontario (Canada)). Nov 1978. 57p. NTIS PC A04/MF A01.

The use of nonaqueous, molten salt and solid electrolytes for high-energy-density storage batteries (SB's) with anodes of Li, Na, Ca, Mg, Al and Ti is discussed. Means to overcome the shortcomings of these systems, viz. low conductivity of the electrolyte, poor quality of the anodic metal deposited during recharging of the nonaqueous systems, high operating temperatures, of the molten salts and instability of solid-state electrolytes are considered. Electrolytes with compositions in the transition region between the pure electrolyte and its solutions in the solvent are suggested for examination in secondary battery systems with each of the six light anodes mentioned above.

4546 (AD-A—064290) **Development of a NICAD battery interface unit. Final report, July 1976-May 1978.** Stephens, E. (Chrysler Corp., New Orleans, LA (USA). Space Div.). Dec 1978. Contract DAAJ02-76-C-0054. 75p. NTIS PC A04/MF A01.

This report describes the effort to develop and test a Battery Interface Unit (BIU) for use on Army aircraft. The BIU provides a means to charge and monitor the status of nickel-cadmium batteries, and is an onboard unit that can be readily integrated with the existing aircraft electrical system. The initial portion of the multitask program involved definition of candidate approaches, analysis to select the optimum approach, and design of a system to implement the multilevel, constant-current approach selected as optimum. Six BIU's were then fabricated, three to operate with an AC input and three to operate from a DC input; they were subjected to a variety of performance and environmental tests to demonstrate performance. The objectives of the program were to develop a system that would reduce battery maintenance cost, increase the useful life of NICAD batteries, and eliminate battery-related safety hazards. The results of the program clearly demonstrated that a BIU can be built which meets these objectives and which can be packaged within weight and volume limits compatible with onbaord aircraft usage.

4547 (AD-A—067210) **Evaluation of liquid-gas separator materials for a silver-zinc cell vent. Final report.** Badcock, C.C.; Zimmerman, A.H. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 15 Mar 1979. Contract F04701-78-C-0079. 20p. NTIS PC A02/MF A01.

The gas permeability of TFE Teflon, FEP Teflon, polyethylene, and microporous Teflon was measured in order to evaluate the suitability of these materials for use as liquid-gas separators for silver-zinc cell vents. Microporous Teflon was found to have ideal characteristics for a liquid-gas separator. This material has a high gas permeability, it is not wetted by electrolyte, and it has a negligible permeability to KOH electrolyte. Microporous Teflon is recommended as the material of choice for liquid-gas separators in silver-zinc battery cells.

4548 (ANL—79-34) **Wetting behavior of molten-chloride electrolytes: capillarity effects in lithium-aluminum/metal sulfide batteries.** Eberhart, J.G. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 41p. Dep. NTIS, PC A03/MF A01.

A lithium-aluminum/iron sulfide battery which uses a molten LiCl-KCl electrolyte is presently under development at Argonne National Laboratory. The performance and lifetime of this electrochemical system depend, in part, on the ability of the electrolyte to wet the materials used as electrodes, separators, and particle retainers. For this reason contact-angle measurements were made on smooth, 100%-dense surfaces of the cell materials. In addition, electrolyte penetrability determinations were made on the porous materials actually used as cell separators and particle retainers. The results of these measurements led to techniques for completely filling porous cell components with electrolyte, suggestions for dealing with the problem of electrolyte creeping, estimates of the likelihood of electrolyte transfer from one porous component to another, and estimation of the maximum allowable vertical cell dimensions. 15 figures, 1 table.

4549 **Research on electrodes and electrolyte for the Ford sodium-sulfur battery. Annual report, June 30, 1976-October 31, 1977.** Washington, DC; National Science Foundation (Apr 1978). 390p. (NP—24057).

Research findings at the University of Utah are reported on the fabrication of pre-sintered β''-alumina tubing, sintering processes for β''alumina, characterization of β''-alumina, and development of a metal clad electronic ceramic (rutile) container or current collector; additional results on topics treated in prior reports are also given. Research reported from Ford Research Staff covers testing of three series of metal prototype cells, development of procedures for α- to β''-alumina and container sealing, sulfur electrode development (shape and surface treatment), materials screening and development of containers including surface treatment and coating, and evaluation of battery requirements (energy, power, volume, weight) for passenger cars. Research reported by RPI covers the kinetics of the sulfur electrode, physical property measurements, mass transport studies, mechanisms of ceramic degradation, and development of new seal glasses. 125 figures, 52 tables.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 5209, 5210

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 4558, 4589, 4703, 4707, 4708

4550 (ORNL/CSD—50) **Energy model validation: initial perceptions of the process.** Mitchell, T.J.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 43p. Dep. NTIS, PC A03/MF A01.

The concept and practice of energy model validation are addressed. The objectives of this work are to give a general indication of what model validation means; to identify, in an organized way, a set of specific questions and activities that are pertinent to model validation; and to indicate ways in which mathematicians and statisticians can contribute in consulting and research roles. The approach includes a breakdown of the model development and modification process into various components: mental model formulation, mathematical model formulation, program design, coding and keypunching, computing process, comparison with data and expectation, real world information process, data generation process, model correction and adjustment, and the policy process. Some standards for the type of extensive model documentation necessary to permit a full-scale validation effort are suggested, and some specific questions to be examined are identified. The process of active validation and the role of mathematicians and statisticians are also discussed. 2 figures, 3 tables. (RWR)

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 4589, 4591, 4596

4551 (DOE/EIA—0201/7) **Taxonomy of energy taxes. Energy policy study. Volume 7.** (National Academy of Sciences, Washington, DC (USA)). Oct 1979. Contract AC01-79EI10496. 53p. Dep. NTIS, PC A04/MF A01.

This report has two major objectives: to provide the US Department of Energy with a taxonomy of the direct Federal, state, and local taxes that differentially affect energy markets, including features of general taxes that affect energy differentially; and to describe some of the important analytical questions associated with the taxes included in the taxonomy. The report does not provide any analysis of those questions, but rather seeks to inform DOE of what the analytical issues are and how they might be addressed. This first part of the report discusses energy taxation within the broad context of energy production and use. The second part includes the formal taxonomy and a detailed breakdown of energy taxes by taxing authority and suggests the important issues that are likely to arise in an analysis of energy taxation. Taxes can affect energy decisions, and it has become apparent in recent years that decisions about energy have become both more important and more controversial.

4552 (FFE—13) **Energy and economic life of local authorities.** Andersson, R. (Stockholm Univ. (Sweden). Forskningsgruppen foer Energisystestudier). Apr 1979. 153p. (In Swedish). Dep. NTIS (US Sales Only), PC A08/MF A01.

This report discusses some important energy problems at the level of local communities from the perspective of social economics. Especially problems related to the pricing and supplying of heat for residences are analyzed. Problems associated with energy-saving measures have been paid due attention in other reports so they are very briefly dealt with in this report. The report starts with a discussion of aims and means in the energy field from society's point of view. Different motives for the state and local communities to intervene with energy policy measures are discussed. It is pointed out that not only pure energy policy measures will influence energy consumption, but that housing and transportation policy measures may also have strong influences. It is thus of importance to consider such effects when making decisions concerning the energy field. Intervention by the state as well by the the local community level is discussed. At the end of this report some project areas suitable for continued research are noted. These are pricing principles for different heating modes, methods to evaluate alternative heating systems from society's point of view, effects of housing policy measures on the consumption of energy, and analysis of the organization of the energy-supply system in local communities.

4553 (SERI/TP—49-186, pp 125-128) **Specific programs of the EX/IM bank.** Wilson, F.E. Jr. (Export-Import Bank, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The direct credit program at the Export-Import Bank of the United States is discussed. A threshold is about $5 million and involves a lot of red tape. The supplier credit concept is almost the opposite of direct credit. It encompasses a large percentage of the Bank's transactions. The suppliers are the ones the Bank deals with, rarely getting involved with foreign buyers. The supplier is responsible for putting together the transaction with the help of the commercial bank they normally work with. The risks are usually covered through bank guarantees or insurance policies and are generally both political and commerial. Specific programs of the Bank are discussed, emphasizing the FCIA insurance program.

4554 (SERI/TP—49-186, pp 129-130) **International activities of the Small Business Administration.** Fleischman, F.S. (Small Business Administration, Atlanta, GA). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

There are 96 Small Business Administration offices throughout the US SBA covers solar energy, export loans, or other business loans in these offices. There are eligible and ineligible types of businesses. Most retail, wholesale, service-type activities, and small manufacturing plants are eligible. Size standards set up by the SBA, interest rates, and associations with banks are described.

4555 **Responsibility of industrialized nations in the energy problem.** Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **24**: No. 5, 230-237(May 1979). (In German).

In view of the fact that some 15% of the world's population today claim some 50% of the world primary energy consumption,

while 52% of the world population must be satisfied with 13% of the primary energy consumption, and in view also of an increase in world population of, at present, approx. 2% per annum, the question arises how to meet the increasing energy demand in the world without incurring international crises and grave economic setbacks. This attempt to find a problem solution is made in the light of the studies of the Conservation Commission of the World Energy Conference. The narrow margin available in the sector of energy policy and the great responsibility of the industrialized nations towards the developing countries are discussed.

4556 IGT experience in energy economics and regional analyses. Chicago, IL; Institute of Gas Technology (1979). 17p. (NP—24026).

IGT's qualifications for performing state and regional surveys in a broad range of energy-related technical and economic areas are described and the following: resource assessment; forecasting demand and supply; utilization assessment and converservation potential; interchangeability of fuels and alternative fuel sources; imports and other supplemental fuel sources; regulatory effects; and siting, systems safety, and environmental considerations.

4557 Assessing new pricing concepts in public utilities. Trebing, H.M. (ed.). East Lansing, MI; Michigan State University (1978). 523p. (CONF-771242—).

From 9. conference of the Institute of Public Utilities; Williamsburg, VA, USA (12 Dec 1977).

Increasing concern over the consequences of introducing significant changes in traditional pricing practices has been displayed. This conference focused on the impact and effects of new pricing concepts, proposals for rate structure reform, and new pricing policies. Whenever possible, the papers drew upon actual experience in analyzing new pricing experiments and new rate structure design, and they emphasized discernible effects rather than further theoretical refinements. The papers also examined the interrelationship between pricing concepts, on the one hand, and new energy sources, changes in market structure, equity factors, and new operating conditions, on the other. The contribution of new metering technology, which is inevitably tied to the implementation of new pricing practices, was also considered.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 4024, 4025, 4032, 4137, 4699, 4901

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 4591, 4704

4558 (Juel-Spez—44) **Applied systems analysis. No. 14. Metal resources - recycling - energy input. Investigation with the aid of a simulation model.** Leimkuehler, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Jul 1979. 294p. (In German). Dep. NTIS (US Sales Only), PC A13/MF A01.

After a rough estimation of magnitudes for energy resources and nonenergy resources, especially metallic resources, a procedure for quantifying estimations of mineral reserves and resources which up to now have been more or less vaguely circumscribed pictorially (McKelvey-Diagrams) is developed. Taking attempts foregone in this field (Lasky-Distributions) existing models for the mineral resources sector are being examined closely and their respective advantages and conceptual weak points are discussed extensively. Thereafter a global simulation model for the mineral resources sector which tries to avoid some of the more obvious pitfalls of previous models is shown; this model enables the user to estimate simultaneously energy saving and mineral resources saving by enforced recycling on a global scale.

4559 (ORNL/SUB—7549/1) **Renewable energy resource and technology assessment: Southern Tier Central Region, New York, New York. Renewable Energy Resource Inventory; renewable energy technology handbook; technology assessment workbook.** (Southern Tier Central Regional Planning and Development Board, New York (USA)). Dec 1978. Contract W-7405-ENG-26. 191p. Dep. NTIS, PC A09/MF A01.

The Renewable Energy Resource Inventory contains regional maps that record the location of renewable energy resources such as insolation, wind, biomass, and hydropower in the Southern Tier Central Region of New York State. It contains an outline of a process by which communities can prepare local renewable energy resource inventories using maps and overlays. The process starts with the mapping of the resources at a regional scale and telescopes to an analysis of resources at a site-specific scale. The resource inventory presents a site analysis of Sullivan Street Industrial Park, Elmira, New York.

4560 (PB—295033) **Status of the mineral industries. Special pub.** (Bureau of Mines, Washington, DC (USA)). 1979. 46p. NTIS PC A03/MF A01.

The report provides a written and graphic view of the Nation's mineral position and its mineral industries. It describes recent activities in mineral production, consumption, imports, exports, and uses of significant minerals and mineral raw materials. Charts profile trends for the past 25 years in supplies and uses of iron, steel, major nonferrous metals, primary nonmetallic construction raw materials, fertilizers, and plastics. Also included are current and historical financial data on the mineral industries, such as debt-to-equity ratios, asset-to-liability ratios, and plant and equipment expenditures.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 4590, 4610, 4698, 4707

4561 (AD-A—067333) **Navy energy R and D program summary FY 1979 - FY 1984. Technical report.** (Tetra Tech, Inc., Arlington, VA (USA)). Feb 1979. Contract N00014-78-C-0434. 29p. NTIS PC A03/MF A01.

This report presents in abbreviated and updated form, the total Navy energy R/D program. It highlights energy R/D program objectives, goals and strategies; the energy R/D program and program management; and cooperative energy technology and demonstration projects with other Federal agencies. Its most important function is to show progress in Navy energy projects in the areas of conservation, synthetic fuels, and self-sufficiency.

4562 (DOE/US—0003) **Overview of technology commercialization assessment.** (Department of Energy, Washington, DC (USA)). Nov 1978. 45p. Dep. NTIS, PC A03/MF A01.

The initial results of a set of commercialization activities in the DOE are reported. These activities study a series of technologies with near-term commercial potential in order to determine what barriers exist to prevent immediate commercialization of these technologies and what range of Federal actions could potentially overcome the barriers. The first set of technologies analyzed using this concept are grouped into separate markets as follows: liquid fuels (enhanced oil recovery, coal liquefaction, oil shale); gaseous fuels (enhanced gas recovery, low, medium, and high Btu gasification); electric markets (utility atmospheric fluidized-bed combustion, combined cycle/integrated gasifier, fuel cell power plant, hydrothermal/geothermal, low-head hydropower, photovoltaics, large and small wind systems); and direct end use (urban wastes, cogeneration, industrial atmospheric fluidized bed combustion, solar hot water, passive solar heating, oil-fired heating equipment, high efficiency motors, air-fuel ratio combustion control, and electric and hydrid vehicles). The study approach is described. (MCW)

4563 (SAN—1573-T1) **Guide for commercialization of energy-related new products or processes. Final report.** (General Technical Services, Inc., Upper Darby, PA (USA)). 1979. Contract EX-77-C-03-1573. 92p. Dep. NTIS, PC A05/MF A01.

This guide was prepared for small technical companies and inventor-entrepreneurs for the commercialization of energy-related new products or processes. Tasks I, II, III, IV, and VII are included in this Final Report. Tasks V, VI, VIII, IX, and X are concerned directly with the preparation of the book and are contained in the manuscript which has already been submitted to the Inventions Program Office. The tasks included are: Functional Analysis of the Commercialization Process; Analysis of ERDA/AASRC (American Association of Small Research Companies) Seminars; Identify Barriers to SBI Participation; Identify SBI Marketing Needs; and Cost Benefit Analysis of Publishing Options. (MCW)

4564 IGT research experience in technical assessment. Chicago, IL; Institute of Gas Technology (1979). 14p. (NP—24024).

Engineering and technical assessments at the Institute of Gas Technology range from evaluations of specific energy industry equipment (heat pumps, Stirling engines, etc.) to advanced energy systems (ocean thermal energy conversion, offshore wind energy conversion system, coal conversion, and solar and hydrogen systems). The studies cited in the project summaries emphasize IGT's work on assessment of advanced energy systems.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 4070, 4072, 4506, 4507, 4558

4565 (NTIS/PS—79/0373) **Energy parks (a bibliography with abstracts). Report for 1964-March 79.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). May 1979. 97p. NTIS PC N01/MF N01.

Energy centers wherein nuclear facilities are clustered in and delimited to a relatively small number of locations throughout the United States are discussed in this bibliography of Federally-funded research. Topic areas cover technical, environmental, and socioeconomic factors involved in facilities siting including resource requirements, atmospheric considerations regarding the impact of heat dissipation, and comparisons between dispersed nuclear power plants nuclear energy centers. (This updated bibliography contains 90 abstracts, 21 of which are new entries to the previous edition.)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 4530

4566 (NP—24168) **Storage and transmission of secondary energy.** Taube, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1979. 27p. Dep. NTIS (US Sales Only), PC A03/MF A01.

In the area of the total energy flow, possibilities and limits of shifts in time (storage) and in space (transfer) of secondary energy, i.e., electrical, chemical, and thermal energy are examined and formulated. These shifts are linked to the qualitative conversions of secondary energy. The multiple technological possibilities, the spectrum of governing factors, and the numerous technical and economical parameters show that only a complex optimization is possible.

4567 (PNL—2989) **Selected legal and regulatory concerns affecting domestic energy transportation systems.** Schuller, C.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 86p. Dep. NTIS, PC A05/MF A01.

This report provides assessments of eight legal and regulatory concerns that may affect energy material transportation in the US during the rest of the century: state authority to regulate nuclear materials transport, divestiture of petroleum pipelines from major integrated oil companies, problems affecting the natural gas transportation system, capabilities of energy transportation systems during emergencies, Federal coal pipeline legislation, ability of Federal agencies to anticipate railroad difficulties, abandonment of uneconomic railroad lines, and impact of the Panama Canal treaty upon US energy transportation. (DLC)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 4470, 4705, 4708, 4709, 4712

4568 (CONF-790394—) **Cogeneration and North Carolina.** Kohl, J. (ed.). (North Carolina State Univ., Raleigh (USA)). 1979. Contract EM-78-S-01-5152. 73p. Dep. NTIS, PC A04/MF A01.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

A separate abstract was prepared for each of 18 individual presentations. Appendices include lists of participants, speakers, and session chairmen plus California and North Carolina reports and legislation dealing with cogeneration.

4569 (CONF-790394—, pp 2p, Paper 1) **Energy Institute interest in cogeneration.** Bresee, J.C. (North Carolina Energy Inst., Research Triangle Pk.). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The North Carolina Energy Institute was established in 1978 to provide the state with a mechanism for evaluation and support of non-conventional energy systems, like cogeneration, of special value to the state. As a result of competitive solicitation, 18 studies were selected with state funding of $450,000. Because North Carolina imports 98% of its fuel, cogeneration has great potential to contribute to heloping solve the state's energy problem. First, it can increase the efficiency of fuel use. Second, it has a near-term potential to expand the distributed generation of electric power throughout the state. By encountering and solving the contractual and institutional impediments early through cogeneration proposals, the Institute hopes to help solve North Carolina's energy problems.

4570 (CONF-790394—, pp 20p, Paper 2) **Role of cogeneration: past and future.** Franklin, J.C. (General Electric Co., Atlanta, GA). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Within the last two years, cogeneration has gained the increased interest of industrials, electric utilities, and the government. The cause of this intense interest is cogeneration's ability to increase overall energy efficiency and thus reduce our national fuel requirements. The author's suggested definition for cogeneration is: the coincident generation of necessary heat and power - electrical or mechanical - or the recovery of low level heat for power production. With this in mind, cogeneration is examined by reviewing various cogeneration systems providing power and process heat. The advantage of industrial cogenerators being synchronized with the utility power system are discussed. While cogeneration is economic now, future energy costs, refinements, and new developments will make cogeneration economic for more applications in the future. 12 figures.

4571 (CONF-790394—, pp 15p, Paper 3) **Federal Government's role in implementing cogeneration.** Cowles, R.L. (Department of Energy, Washington, DC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The Federal Government's role in cogeneration is viewed within the context of the US energy situation and the impact of the energy situation on the Nation. The National Energy Policy main objectives are defined as: (1) increase energy availability (supply); (2) improve the efficiency of energy use (conservation); and (3) shift to more abundant fuels (conversion). The Department of Energy's Cogeneration Program objectives are reflections of these national energy objectives. Some of the Department of Energy's cogeneration research, development, and demonstration are discussed. The second thrust of the cogeneration program discussed is the commercialization activities consisting of planning, policy development, and technical assistance.

4572 (CONF-790394—, pp 5p, Paper 4) **Cogeneration from a utility point of view.** Denton, D.H. Jr. (Duke Power Co., Charlotte, NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Historically, large utilities were able to supply electric power to industries at lower and lower prices by building larger and larger generating facilities. However, with the abrupt reversal in electric industry economics in 1970, the potential for alternate investments made by the consumer became more feasible when compared with the potential of building more-expensive power plants. One real potential is that of cogeneration. While the utility can encourage it from the standpoint of elimination of future generating capacity, the economics of each cogeneration project should be analyzed. Second, the total energy utilization with regard to availability sources and the impact of legislation on various forms of energy should be evaluated. Last, the interconnection of the cogenerator with the electric utility should be considered.

4573 (CONF-790394—, pp 28p, Paper 5) **Prices and availability of electricity in North Carolina.** Spann, R.M. (North Carolina State Univ., Raleigh). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Factors affecting the price of electricity are presented to help determine cogeneration economics. Cogeneration is considered using hypothetical cases. For example, cogeneration is considered cost-effective under low capital and fuel cost assumptions but not cost-effective given high capital and fuel costs. On net, cogeneration is close to a breakeven proposition. Rate design policies which effect cogeneration economics and other factors affecting electricity prices are outlined. This paper's format is a series of 28 figures.

4574 (CONF-790394—, pp 1p, Paper 6) **Developing basic data on cogeneration prospects for North Carolina.** Kohl, J.; Vaughn, K.; Paddock, R. (North Carolina State Univ., Raleigh). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

To determine the potential for cogeneration in North Carolina, this project tried two approaches to identify and locate companies that might be prospects for cogeneration. The first approach was to examine the records of the North Carolina Boiler Registery. All boilers and large hot-water heaters (industrial and institutional) in North Carolina are registered. The second approach was to examine the State of North Carolina records from the National Emission Data System which included data on energy utilization by all major emitters of air pollutants. A master list of cogeneration prospects was compiled. 5 tables.

4575 (CONF-790394—, pp 13p, Paper 7) **Estimating the potential for cogeneration in North Carolina: methodology and findings.** Harwood, H.J. (Research Triangle Inst., Research Triangle Pk, NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The objective of this study is to estimate the potential for future cogeneration in the State of North Carolina. Topics of interest include the present level of cogeneration in the state, the unutilized or underutilized potential, and the potential resulting from new and

expanded industry. The current level of cogeneration and projections of future cogeneration are expected to be of use in projecting the state's future needs of electrical generating capacity to be met by the class A public utilities. A second objective is to assess the utility of the approach for further applications. The study uses secondary as well as primary data sources. The secondary data sources are the National Emissions Data Survey (NEDS) and the Boiler Registry maintained by the NC Department of Labor. Primary data on fuel use are obtained by a survey of plants and institutions identified through the NEDS and the Boiler Registry as being major fuel users. The author evaluates the relative value of each of these data sources while estimating the potential for cogeneration, and provides some guidance for future studies of a similar nature, either in North Carolina or in other states. 6 tables.

4576 (CONF-790394—, pp 7p, Paper 8) **Implications of the NCSU-TIR study for Federal regulations, the NC General Assembly and the NC Utility Commission. Part I.** Kohl, J. (North Carolina State Univ., Raleigh). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

This paper is part of a larger study to develop data on cogeneration prospects in North Carolina. Existing cogeneration facilities in North Carolina were first identified. Companies presently engaging in cogeneration and considering expansion of their generating capability described three major problems: (1) inability to negotiate a satisfactory arrangement for sale of excess electricity: (2) excessive standby charges; and (3) lack of clarity in Federal Government fuel policies. Contacts with utilities, cogeneration prospects, and vendors of cogeneration equipment have led to the following inputs on problems and possible solutions: (a) implications of type of ownership; (b) availability of waste fuel: (c) cogeneration in State institutions; and (d) implementation of the Clean Air Act. 5 references, 2 tables.

4577 (CONF-790394—, pp 10p, Paper 9) **Implications of the NCSU-RTI study for Federal regulations, the NC General Assembly, and the NC Utility Commission. Part II.** Johnson, S.A. (Research Triangle Inst., Research Triangle Pk., NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Preliminary findings underscore the fact that there is sufficient untapped cogeneration potential in North Carolina to warrant further study by the electric utilities and the North Carolina Utilities Commission as a part of the electric utility capacity expansion approval process. Savings would flow primarily from the impact of shorter construction periods on the total costs of capital. Procedures to remove impediments are discussed. The most-frequently-listed problems include prohibitive buyback and wheeling rate and service practices. The North Carolina cogeneration potential is primarily limited by the domination of light industry with relatively low-base steam loads. Standby charges are discussed. Utility service practices of the major utility companies are compared.

4578 (CONF-790394—, pp 22p, Paper 10) **Impact of the National Energy Act on barriers to cogeneration.** Feldman, R.D. (LeBoeuf, Lanb, Leiby & MacRae, Washington, DC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The National Energy Act fails to provide equal assistance to all types of cogeneration. The character of this assistance is confused by the fact that the National Energy Act is comprised of bills pointed at different objectives, whose implementation is spread between the Federal Energy Regulatory Commission, the Department of Energy, state agencies, and even the Department of Agriculture. This article considers the impact of each of its five laws. When examining particular proposed cogeneration projects it will be necessary to knit together the impact of these several laws. The emphasis is on problem areas which remain under legislation. The five laws examined in detail are: (1) Public Utility Regulatory Policy Act; (2) Powerplant and Industrial Fuel Use Act; (3) Energy Tax Act; (4) Natural Gas Policy Act; and (5) National Energy Conservation Policy Act.

4579 (CONF-790394—, pp 3p, Paper 11) **North Carolina regulatory barriers to cogeneration: summary.** Allan, D. (North Carolina Utilities Commission, Raleigh). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The various positions of the Public Staff, North Carolina Utilities Commission, on cogeneration are stated. The Public Staff endorses cogeneration for industries which utilize on-site boilers to meet internal needs for electric power and process heat and for industries which anticipate that their own facilities will produce electric power or proces heat in excess of their own needs. Some areas where cogeneration questions arise are in the areas of rate regulation, ownership, eminent domain, and legal organization. Although some statutory barriers exist to cogeneration, the extent of possible regulation by the North Carolina Utilities Commission seem minimal when compared to the potential benefits to industry and the wise use of our energy resources.

4580 (CONF-790394—, pp 3p, Paper 12) **California Public Utility Commission actions designed to encourage cogeneration.** Dedrick, C.T. (Public Utilities Commission of California, San Francisco). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The California Public Utility Commission began in 1978 to encourage cogeneration in line with their broad goals of efficienct use of fuels, energy conservation, and reasonable energy rates. The initial step was to identify cogeneration potential. New standby tariffs were designed to encourage cogeneration. A statue exempts from California Public Utility Commission jurisdiction cogenerators who sell surplus energy to utilities and other public entities. This had been a major fear of industries considering cogeneration. Other institutional barriers being looked into by California are: wheeling, siting, rates, and pollution regulations.

4581 (CONF-790394—, pp 7p, Paper 13) **Experiences in encouraging cogeneration.** Kulvicki, R. 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

After a brief history of cogeneration and cogeneration studies, the author reviews the sequences of steps he followed in 1977 to develop the largest number of potential candidates for cogeneration in Southern California. The author submits several personal recommendations for North Carolina utilities interested in cogeneration. These recommendations are applicable to utilites in general.

4582 (CONF-790394—, pp 2p, Paper 14) **North Carolina Utilities Commission and cogeneration.** Koger, R.K. (North Carolina Utilities Commission, Raleigh). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

The Public Utilities Regulatory Policies Act of 1978 directs the Federal Energy Regulatory Commission to prescribe rules necessary to encourage cogeneration. Each state is charged with implementation of those rules. Certain North Carolina requirements, like certification, that tend to discourage cogeneration need to be altered. Establishement of a Cogeneration Advisory Committee and a technical services group were suggested to effect cogeneration in North Carolina.

4583 (CONF-790394—, pp 10p, Paper 15) **Experiences with cogeneration in the tobacco industry.** Vogler, R.A. (R.J. Reynolds Tobacco Co., Winston-Salem, NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

In the early days almost any large manfacturing plant had to be self-sufficient. The evolution of cogeneration at the R.J. Reynolds plant is outlined. The plant presently generates electricity based on its steam demands and purchases the remainder from Duke Power Company. Operating parameters are outlined for the manufacturing complex in downtown Winston-Salem, NC. Expansion in the suburb of Whitaker Park does not contain any electrical cogeneration. Excess steam drives mechanical loads instead. 6 figures.

4584 (CONF-790394—, pp 29p, Paper 16) **Recent examination of the payout for cogeneration in industrial plants.** Entwistle, J. (Fiber Industries, Charlotte, NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Cogeneration was studied for small, medium, and large industrial plants. A small plant is defined as having a steam consumption rate of less than 100,000 pounds per hour (pph). A medium-size plant has a steam load up to 400,000 pph. A large plant is in the 1,000,000-pph range. Cogeneration in the small plant is not financially attractive. In the medium-size plant, cogeneration gives a marginally attractive return on investment and a significant reduction in the cost of steam. Short depreciation periods and increases in the investment tax credit will stimulate cogeneration applications in plants of this size. The large plant can produce electricity for export to the utility company grid at competitive prices. This size of project is very suitable as a joint industry-utility company venture. 5 references, 11 figures, 12 tables.

4585 (CONF-790394—, pp 23p, Paper 17) **Co-generation application at King's Mountain, NC.** DeBoe, H.M. (Campbell, DeBoe & Associates, Cleveland, OH). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

This paper describes a particular application of cogeneration that involves a municipal electrical-generation system and six industrial organizations that are process steam users. Steam and electric power is produced at a central facility; electrical generation forms the power source for a municipal electric-generating system, and the extracted steam is used for process in industries located in an

adjacent industrial park. A cogeneration facility is described that has been developed to supply the steam facilities both presently and in the future, and the results of operation of the cogeneration facility is presented. Cost for ownership and operation of the cogeneration facility is compared to estimated costs for providing electric power and steam services in the conventional manner. 9 figures, 5 tables.

4586 (CONF-790394—, pp 4p, Paper 18) **Cogeneration in the pulp and paper industry.** Fox, E.C. (Federal Paper Board Co., Riegelwood, NC). 1979.

From Cogeneration and North Carolina; Raleigh, NC, USA (7 Mar 1979).

Cogeneration in the pulp and paper industry has been an accepted practice for many years. The industry has the main two ingredients that normally make cogeneration feasible: the need for a continuous supply of low-pressure steam and a large demand for electric power. In past years cogeneration was a necessity because electric power in sufficient quantities was not available at otherwise desirable plant sites. Paper mills normally operate their boilers at pressures from 400 to 1750 psig and utilize steam in their processes at 50 and 150 psig. Mills of recent design have elected to go to the higher boiler pressures to increase the amount of electric power generation.

CONSERVATION

REFER ALSO TO CITATION(S) 4530, 4610, 4614, 4620, 4621, 4668, 4695, 4699, 4703, 4704, 4710, 4711

4587 (AD-A—063936) **Recommended interface standards for an Army Standard Energy Monitoring and Control System. Final report.** Hall, J.L. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Dec 1978. 37p. NTIS PC A03/MF A01.

This report evaluated existing interfacing standards for use with an Army Standard Energy Monitoring and Control System (EMCS). The interfacing requirements for the Army Standard EMCS and the criteria for making the required evaluations are presented. Descriptions of the existing standards which were found to be candidates for evaluation are presented, along with the results of the evaluations. This report recommends that for the Army Standard EMCS, a concept similar to IEEE standard 583 be used for parallel data interface and that the EIA R232-C standard be used for serial data interfaces.

4588 (CONS—5097-T2) **Financing residential energy conservation in the state of Washington.** Mack, R.S.; Fairburn, W.A. (Central Washington Univ., Ellensburg (USA). Energy Studies Center). Dec 1978. Contract EC-77-G-01-5097. 79p. Dep. NTIS, PC A05/MF A01.

The Washington Energy Extension Service Finance Program was commissioned for the overall purpose of facilitating and assessing the development of energy-related loan policies by financial institutions. Explicit objectives of the project are to: identify financial problems of small energy consumers in the domestic installation of energy-saving technologies; identify the financial options currently available in the State of Washington; and in concert with the financial institutions of the state, develop and analyze recommended additional programs which will benefit both consumers and financial institutions. This final report of the WEES Finance Program extends the rate-of-return analysis to include the overall required rates of return necessary to justify various commercial bank functional activities; with judicious implementation, this methodology can be a substitute for the subjective risk-assessment techniques currently utilized in the commercial banking sector. This report also considers changes that have occurred in the development of financial options related to energy-conservation measures.

4589 (K/D—5005) **Calculating the discounted payback period for energy-conservation projects.** Shelton, R.L. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1979. Contract W-7405-ENG-26. 9p. (CONF-791069—1). Dep. NTIS, PC A02/MF A01.

From 6. annual conference on energy; Rolla, MO, USA (16 Oct 1979).

This paper highlights the techniques of economic analysis utilized by the Department of Energy for its In-House Energy Management Program while focusing on the payback period, a parameter which has served as a traditional measure of economic performance from a capital investment. Calculation of a discounted payback period which accounts for the time value of money and the effect of energy-price escalation is recommended as a procedure for providing a more-realistic assessment of energy-conservation projects.

4590 (LBL—9715) **Energy-savings potential of the Region IX Appropriate Energy Technology Grants Program: an assessment of twenty projects.** Lucarelli, F.B.; Morris, J.; Kay, J.M.; Rizer, S.; Case, C.W.; Clark, H.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 162p. Dep. NTIS, PC A08/MF A01.

LBL selected a representative sample of 20 projects from 5 sub-regions (Arizona, California, Hawaii, the western Pacific, and Nevada). The projects were selected because they are amenable to quantitative analysis. Of the 20 projects, 12 use solar technologies, 4 use bioconversion technologies, and 1 develops a geothermal heat source. Eight projects are for space and water heating in the residential and commercial sectors, and 4 use solar energy for the process heat requirements of industrial firms. The projects demonstrate in a classic manner the value of appropriate technologies in achieving a thermodynamic match between an end use energy requirement and a given energy supply. LBL has evaluated the 20 projects for direct and indirect energy savings and has expressed these savings in terms of end use and primary energy savings.

4591 (ORNL/Sub—7594) **Energy Conservation and Development Plan. Southern Tier Central Region, New York.** (Southern Tier Central Regional Planning and Development Board, New York (USA)). Jul 1979. Contract W-7405-ENG-26. 61p. Dep. NTIS, PC A04/MF A01.

A summary is presented of the work of 40 volunteers working with regional planners to imagine, assess, and prescribe for the development of local energy resources (wind, solar, biomass, and water) and for conservation of all forms of energy. The plan contains a brief summary of the process the citizens followed in formulating the plan, the plans themselves, and appendices which contain more detailed comments by citizens on the possible consequences of the development of each resource. The areas (Chemung, Steuben, and Schuyler counties) experienced severe natural gas curtailments during the winter of 1976-1977. The formulation of an emergency energy conservation plan is also presented.

4592 **Project Conserve in Illinois.** Springfield, IL; Illinois Institute of Natural Resources (1979). 13p. (NP—24114).

Project Conserve provides homeowners with an easy and effective analysis of their energy usage. The focus is on providing a factual basis for better decision making, thus encouraging homeowners to take the recommended actions. The distribution system of the program in Illinois, its program costs, and promotional programs implemented for the program are summarized.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 4551, 4706

4593 (DOE/EIA—0202/1) **Short-term energy outlook: October 1979.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 129p. Dep. NTIS, PC A07/MF A01.

This report provides revised monthly and quarterly projections for 1979 and 1980 for all major energy products. The revised projections take these newer developments into account and reflect recent changes in the economic outlook and the availability of petroleum supplies. The report is divided into four major sections: Overview, Forecasts, Analysis, and Methodology. The Overview section presents a summary of the contents of the report. The Forecast section, which is delineated by fuel types, has been designed to be used as a quick reference guide for forecasts on a specific fuel. The Analysis section contains an in-depth discussion of selected forecast data, while the Methodology section discusses the procedures used to generate the forecasts.

4594 (DOE/TIC—10295) **National energy problem in perspective.** Sanders, J.P. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

A study of the history of energy usage in this country will indicate a take off in energy consumption rate occurred in the mid-1950s; this was followed by an increase in the use of electricity as a more convenient energy source in the mid-1960s. Associated with the generation of increasing amounts of electricity were the conversion losses inherent in normal steam cycles. Future needs can be projected on the basis of the population growth and the energy consumption rate per capita. An extrapolation of these needs minus the amount of fossil fuel that can be obtained or afforded shows clearly the demand placed on domestic supplies. After an allowance is made for the remaining fossil reserves plus optimistic projections for energy from geothermal, hydroelectric, oil shale, and solar sources, a deficit remains. It appears that nuclear fission energy is the only developed source that has a possibility of filling this deficit between the present and the year 2000. Past that date, there is hope that nuclear fusion energy or some other of the developing technologies will be available to supply the need.

4595 (IVA—112) **Social supply of raw materials when there is a shortage of energy.** Kihlstedt, G. (Ingenjoersvetenskapsakademien,

Stockholm (Sweden)). Oct 1977. 87p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

At least in the following two decades the shortage of energy resources is a fact. The social impacts of this shortage of raw materials are discussed.

4596 (Juel-Spez—41) **Applied systems analysis. No. 12. Cost-effective development perspectives for the space heating sector in the energy supply system of the German Federal Republic - an optimization model.** Egberts, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Jun 1979. 254p. (In German). Dep. NTIS (US Sales Only), PC A12/MF A01.

Development and market penetration of new energy supply technologies become under the conditions of increasing oil scarcity and cost-effectiveness of more and more vital concern to most industrialized societies. An essential prerequisite of a sensible energy technology policy is the assessment of the different technical processes of energy supply and utilization with respect to their economic suitability, security of supply, and environmental neutrality. It has been tried to make a contribution here using a dynamized linear optimization model of the FRG's energy supply. Among the various forms of energy utilization the main interest with the model formulation is put on the space heating sector. On the supply side electricity and heat production and coal conversion are the most important sectors. The model results show a clear and stable tendency towards district heating and gas utilization for space heating. Within the primary energy supply the crude oil consumption is stabilized even with a rather modest rate of energy price increases. Besides a certain expansion of the natural gas sector the growth of energy demand is predominantly met by coal and nuclear energy.

4597 (NP—24101) **Energy security for the eighties: a policy for Ontario.** (Ontario Ministry of Energy, Toronto (Canada)). Sep 1979. 20p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A policy for Ontario for energy security is discussed in the following topics: Ontario's energy future: facing facts for the eighties; Ontario's response to the crude oil deficit; framework for crude oil self-sufficiency by 1995; National Plan for crude oil self-sufficiency by 1995; Ontario's proposal for a National Plan for crude oil self-sufficiency; natural gas: a policy on price and supply; consumer and job protection: adjustments to higher oil prices; a National Petroleum Company: a basic need; Ontario's energy security: a provincial policy; Ontario's indigenous energy supply - 1978-1995; the cost; conservation and reduced energy growth; Zero Crude Growth by 1985; and initiatives to achieve Zero Crude Growth. (MCW)

4598 (NSF/RA—790002) **Final report and proceedings: workshop on appropriate technology.** (Design Alternatives, Inc., Washington, DC (USA)). 1978. 371p. (CONF-780170—). National Science Foundation, Office of Problem Analysis, 1800 G St., NW, Washington, DC 20550, Free.

From Workshop on appropriate technology; Harpers Ferry, WV, USA (23 Jan 1978).

The workshop was convened to examine and document locally-focused issues in the field of appropriate technology. A research agency and program guidelines, that could be considered by the Directorate of Applied Science and Research Applications of the National Science Foundation in planning a distinct research program in appropriate technology, were recommended. Section I contains information about the background and purposes of the project, including the rationale for a research program in appropriate technology, the research agenda, and program development guidelines. Section II contains background information about the issues examined during the project, including copies of the project overview and overview of workshop events. Section III contains the proceedings of the workshop process, including 25 final papers written by facilitators and participants, and other documentation of the ideas and recommendations made by those who attended the workshop.

4599 **Energy choices for California...looking ahead.** Sacramento, CA; California Energy Commission (Mar 1979). 247p. (NP—24099). California Energy Commission, 1111 Howe Ave., Sacramento, CA.

A review of the present California energy situation is presented and a preview of the California Energy Commission's analysis of major energy issues is provided. Part 1 of the report, Trends and Choices, is an overview of California's energy situation from 1977 to 1979, and introduces some of the major themes and strategies encountered throughout the discussion of the electricity sector. It concludes with a brief examination of background issues in the oil and gas sector, which accounts for over 90% of the state's energy supplies. Part 2 is an extensive analysis of issues and options in the electricity sector, where the Commission's primary regulatory responsibilities lie. After exploring several approaches for balancing the electricity supply/demand equation in California, the concluding portions describe ongoing Commission efforts to identify and resolve constraints on power plant siting, and to develop the detailed demand forecast required in the Commission's Electricity Forecasting and Planning Report. Part 3 provides further background on efficiency-improving and innovative technologies that promise to play an increasingly important role in California's energy future. (MCW)

4600 **Roads to energy self-reliance: the necessary national demonstrations.** Ottawa, Ontario; Science Council of Canada (1979). 200p. (NP—24127). Canadian Government Publishing Centre, Supply and Services Canada, Hull, Quebec K1A 0S9 $4.0.

If Canada is to (a) avoid the economic disruptions caused by large imports of increasingly expensive oil; (2) minimize the impact of politically motivated interruptions of this dominant resource; and (c) systematically develop long-term sources and technologies leading to self-reliance, it must: in the short term, find effective ways to minimize oil imports by conservation, substitution by alternative fuels, improved energy conversion processes, and more effective recovery of other hydrocarbon resources. In the long term, it must explore those energy opportunities most appropriate to satisfy Canada's projected match of requirements and resource contributions. A number of energy use and supply technology options must be studied simultaneously. This report documents the need for a national energy demonstrations program and recommends that certain vital technology demonstrations be undertaken without delay. Prompt implementation on the basis of currently available information, with periodic reassessment and priority determination as the demonstrations program progresses is recommended. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 4009, 4571, 4578, 4579, 4597, 4665

4601 (SERI/TP—49-186, pp 113-116) **International Energy Development Program.** Tardiff, A.N. (Dept. of Energy, Washington, DC). Apr 1979.

From DOE/solar export opportunities workshop; Atlanta, GA, USA (8 Jan 1979).

The IEDP constitutes a US bilateral initiative in relationships with developing countries that was initiated by the President in September 1977. It aims to develop an awareness of appropriate nonnuclear energy alternatives and supports other US policies concerned with US export expansion, world energy supply, and economic development assistance. A pilot phase has been conducted and it demonstrates that it is capable of supporting these policy objectives, accomplishing this through collaborative energy assessments with selected developing countries. Two such assessments were performed in Egypt and Peru during the pilot phase. The assessment programs are described and the results summarized. (MCW)

4602 (LIB-tr—4767) **Law governing the conservation of energy in buildings (Energy Conservation Law - EnEG).** Translated from *Bundesgesetzblatt, Teil I;* No. 87, 1873-1875(28 Jul 1976). 9p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Laws passed in the Federal Republic of Germany by July 1976 pertaining to energy conservation in new buildings are listed. These laws regulate such matters as thermal insulation and the performance of space and water heating systems. (LCL)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 4024, 4025, 4558

COAL

REFER ALSO TO CITATION(S) 4009

PETROLEUM

REFER ALSO TO CITATION(S) 4009, 4018, 4026, 4027

NATURAL GAS

REFER ALSO TO CITATION(S) 4031, 4035, 4557, 4713

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 4044

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 4125

ELECTRIC POWER

REFER ALSO TO CITATION(S) 4471, 4475, 4557, 4577, 4615

4603 (CONF-780983—, pp 459-460) **Control methods for solar heating systems that reduce electric utility peak loads.** Lorsch, H.G. (Franklin Research Center, Philadelphia, PA). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of this project is to determine ways and means of controlling solar systems so that electric utility load peaks caused by backup requirements to solar heating/cooling systems will be reduced.

4604 (CONF-780983—, pp 461-462) **Management of electrical backup demand for solar heating and cooling applications.** Debs, A.S. (Georgia Inst. of Tech., Atlanta). Mar 1979.

From 3. solar heating and cooling R and D branch contractors' meeting; Washington, DC, USA (24 Sep 1978).

The objective of the project is to study solar controller and system design in the presence of auxiliary electrical backup and load management restrictions for peak shaving of utility power supply. Emphasis is placed on solar direct heating, solar-assisted heat-pump systems and rankine-cycle systems supplying energy needs of single-family residences.

4605 **Review of power planning in the Pacific Northwest, calendar year 1978.** Harper, Z.R.; King, V.G. Vancouver, WA; Pacific Northwest River Basins Commission (1979). 113p. (NP—24160).

This publication reviews some of the activities that occurred in the electric power industry in the Pacific Northwest during 1978. Chapter I discusses the significant power planning related events, activities, studies, and reports which occurred or were issued during the year. Chapter II presents utility load estimates through the year 2020. Chapters III and IV review the resources existing, under construction, and feasible for development in meeting the forecast loads. Chapter V gives a review of some of the research and development activities underway in the electric power field. Chapter VI, Comparison of Loads and Resources, takes into consideration all of the information presented in previous chapters and gives the overall picture of the power situation in the Pacific Northwest. Current generation installation schedules indicate that the addition of about 14,188 MW of peak capability is needed during the next 10 years, consisting of 1708 MW of additional hydro resources and a net gain of 12,480 MW of new thermal resources. These installations will produce about 8274 MW of additional energy, of which about 44 MW will come from hydro and a net gain of 8680 MW from thermal. Chapter VII discusses the activities of the Power Planning Committee during the year, with a list of Committee publications included. A project index and a subject index follow Chapter VII. A map titled Electric Power Plants in the Pacific Northwest and Adjacent Areas is included.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 4137, 4476, 4477, 4478

4606 (DOE/EIA—0191(78)) **Cost and quality of fuels for electric utility plants: 1978. Energy data report.** Rhodes, S. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 54p. Dep. NTIS, PC A04/MF A01.

Annual information on the cost and quality of fossil fuels delivered to electric utilities generating plants in the US with a combined capacity of 25 MW or greater is reported. In this series of reports, beginning with the 1976 annual summary report, plant-by-plant data are grouped on a state and regional basis to enable comparison of prices of similar fuels delivered to other plants in the same state and region. In 1978, the production of electric energy rose 3.9%, reaching a record 2207 billion kWh. The biggest increase in electric generation occurred in hydroelectric units and the second largest increase came from nuclear plants. Total electric power generation and fossil fuel consumption by electric utilities for the period 1975-1978 are tabulated. Unit prices of fossil fuels increased an average of 8.8% in 1978. Utilities reported purchasing 476.2 million tons of coal, 606 million barrels of oil, and 3123.9 billion cubic feet of gas. Additional data are provided in appendices. (MCW)

4607 (DOE/ERA—0020(Rev.1)) **Additions to generating capacity 1979-1988 for the contiguous United States, as projected by the Regional Electric Reliability Councils in their April 1, 1979 Long-Range Coordinated Planning Reports to the Department of Energy.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Oct 1979. 176p. Dep. NTIS, PC A09/MF A01.

This report summarizes the generating-unit capacity changes projected for 1979 to 1988 by the Regional Electric Reliability Councils in their April 1, 1979, Coordinated Long-Range Planning Reports to the Department of Energy. Table H itemizes the individual generating units projected for construction, retirement, uprating, and derating during 1979 to 1988 according to Item 2B of the nine Reliability Council reports. Tables 1 through 6 provide summaries of the Table H information in several different categories and groupings. New generating units to be completed by the end of 1988, according to Table 1, total 712, representing 285,363 megawatts. In addition, 4 windpower installations totaling 55 MW are to be completed by the end of 1988. Table 3 shows that 340 units totaling 11,602 MW are to be retired. In addition to capacity changes due to installation of new units and retirement of older ones, there are capacity changes due to upratings and deratings. Two tables show that the total capacity increase projected for 1979 to 1988 is 24,185 MW less than the total increase projected for 1978 to 1987.

4608 (INKA-Conf—79-095-001) **Problem of peak loads in the electric power industry.** Loew, H. (Isar-Amperwerke A.G., Muenchen (Germany, F.R.)). 1979. 18p. (In German). (CONF-7905117—4). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Conference on power demand and supply - analysis and strategies; Schliersee, F.R. Germany (16 May 1979).

Peak electric power demands are mainly met by utilizing as much as possible plants designed for peak demand, and by increasing the share of cost-favourable basic load production in the total production as far as possible. In this system, improvements are principally possible, even if they are difficult to realize. The problems are especially seen in the difference between summer and winter load diagrams. The extension of the so-called peak load power plants is mainly a technical problem resulting from the fact that electrical energy cannot be stored. This problem must be solved during balanced load process for reasons of controlling and guaranteeing the supply during times of failure of the power plant.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 4552, 4610, 4667, 4668, 4669, 4697

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 4601

SOLAR

REFER ALSO TO CITATION(S) 4138, 4139, 4140, 4141, 4142, 4143, 4144, 4145, 4149, 4150, 4151, 4152, 4153, 4154, 4155, 4156, 4158, 4159, 4160, 4161, 4162, 4163, 4164, 4165, 4166, 4167, 4188, 4214, 4218, 4219, 4228, 4245, 4311, 4312, 4325, 4332, 4554, 4603

OTHER

REFER ALSO TO CITATION(S) 4202, 4204, 4205, 4206, 4208

ENERGY CONVERSION

MHD GENERATORS

4609 (NTIS/PS—79/0608) **Magnetohydrodynamic generators in power generation (a bibliography with abstracts). Report for 1964-May 79.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 238p. NTIS PC N01/MF N01.

The citations include research on performance, costs, efficiency, and design of MHD generators and their use in fusion and fission reactors, and fossil fueled plants. (This updated bibliography contains 232 abstracts, 31 of which are new entries to the previous edition.)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

4610 **IGT research experience in energy utilization and conservation.** Chicago, IL; Institute of Gas Technology (1979). 14p. (NP—24025).

Research in energy utilization at IGT covers a broad range of studies in the industrial, vehicular, residential-commercial, and agricultural fields. The main thrust of industrial work has been to

improve the combustion efficiency of industrial furnaces and boilers, conserve fuels, further the application of fuels interchangeability and alternative fuels, recover waste heat for useful purposes, and reduce undesirable emissions. Residential-commercial studies range from the development of more energy-efficient appliances to the analysis of solar-assisted total energy systems. In the agricultural field, IGT has studied the use of wind-powered hydrogen-electric systems for various farm types and climates.

BUILDINGS

REFER ALSO TO CITATION(S) 4587, 4602, 4707, 4840

4611 (INKA-Conf—78-276-005) **Comparative energetic evaluation of heat pump condensers.** Bauder, H.J. (Sulzer-Escher Wyss G.m.b.H., Lindau (Germany, F.R.)). 1978. 23p. (In German). (CONF-7810193—2). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Annual meeting DKV: cryogenics and air conditioning in maritime regions; Hamburg, F.R. Germany (11 Oct 1978).

If screw-type, open, and closed piston compressors for heat pumps are compared on the basis of the energy term, the result differs from that of an assessment on the basis of thermal efficiency or performance. For average temperature differences between heat source and heat sink, these differences correspond to normal design-based differences in efficiency between the compressor types compared.

4612 (INKA-Conf—79-026-002) **Technology of exploitation of the heat source ground water.** Kuhrwahl, H. (Hamburgische Electricitaets-Werke A.G. (Germany, F.R.)). 1979. 6p. (In German). (CONF-7904113—4). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Expert meeting on chances and limits of heat pumps in practical use; Dortmund, F.R. Germany (25 Apr 1979).

In the North German lowlands, where the ground water level is relatively high, about 2,000 groundwater heat pump heating systems are in operation today. The oldest of these is more than 10 years old. Of the installed heat pump heating systems (air/ground/groundwater), they still form the biggest number. Methods of exploitation and prices are dealt with.

4613 (INKA-Conf—79-026-003) **Effects of heat removal on groundwater.** Balke, K.D. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Geologie und Palaentologie). 1979. 21p. (In German). (CONF-7904113—3). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Expert meeting on chances and limits of heat pumps in practical use; Dortmund, F.R. Germany (25 Apr 1979).

On the primary energy side, ground-water heat pump systems consist essentially of a producing well, the heat pump proper, and an absorption well. During operation water cooled down in the heat pump is led back into the water-bearing stratum around the absorption well, forming a cool region around it which is referred to as negative thermal anomaly. Size and shape of this anomaly are important parameters in dealing with problems of siting and quality. For a practice-oriented investigation of the time- and location-dependent formation of the negative thermal anomaly around absorption wells of heat pump systems, two hydrothermal test fields have been operated since Mid-1978. They are connected with groundwater heat pumps that have been in operation for several years.

4614 (INKA-Conf—79-026-004) **Efficient use of energy - alibi or responsibility.** Kliemt, W. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.)). 1979. 11p. (CONF-7904113—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Expert meeting on chances and limits of heat pumps in practical use; Dortmund, F.R. Germany (25 Apr 1979).

In this opening speech, some general remarks concerning energy policy from the point of view of an energy-supply enterprise are given. References to heat pumps are seen in the fact that this technology brings a more rational energy utilization and supports a reduction of the fuel oil demand by more intensive utilization of inland hard coal for current production for space heating.

4615 (INKA-Conf—79-026-005) **Supply tariffs.** Aundrup, H. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.)). 1979. 23p. (In German). (CONF-7904113—2). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Expert meeting on chances and limits of heat pumps in practical use; Dortmund, F.R. Germany (25 Apr 1979).

Using load diagrams as the basis for the discussion, some preconditions for controlling and charging for heat pump power supplies are explained. At the same time, utilities' efforts to shave load peaks are stressed.

4616 (INKA-Conf—79-026-006) **Chances and limitations of heat pumps in practical use.** Kersting, E. (Olsberger Huette Hermann Everken K.G., Olsberg (Germany, F.R.)). 1979. 24p. (In German). (CONF-7904113—5). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Expert meeting on chances and limits of heat pumps in practical use; Dortmund, F.R. Germany (25 Apr 1979).

The results and experiences made in the pilot systems for the design of the individual components: evaporator, condenser, compressor, etc., are the basis for the construction of other systems. Especially the progress in evaporator defrosting could be successfully transferred to the large project in Dortmund. The same is valid for experiences in the fields: air- and body noise reaction, leading of the air flows, and simplification of mounting. Thus the method used was confirmed as correct. The electrical air-to-water heat pump with exclusive use of the heat source air has fulfilled expectations. It will take its place among the energy saving heating systems.

4617 (LBL—8785) **Infiltration-pressurization correlation: surface pressures and terrain effects.** Sherman, M.H.; Grimsrud, D.T.; Diamond, R.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 49p. (EEB-ENV—79-4). Dep. NTIS, PC A03/MF A01.

Expressions for theoretical predictions of infiltration due to combined stack and wind effects are derived. The surface pressure distribution around the shell of a structure can be estimated from measurements of the neutral pressure levels and weather and terrain parameters. A simple linear model of infiltration is used to calculate the infiltration from the surface pressure distribution and leakage measurements. An experimental procedure is outlined for measuring the neutral level.

4618 (STU—77-4960) **Construction of a total energy system with a Stirling engine as a driving motor: a test installation in a building.** Nelving, H.G.; Gummesson, S. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). May 1979. 82p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

The aim of the project was to develop and test a heat pump system driven by a Stirling engine for space heating. The saving in the energy costs by using this system is calculated and the environmental effects of the system are studied. It was found that the system described in this work will be suitable for the heating of apartment houses, office buildings, commercial buildings and hospitals, and may be combined with air conditioning and reserve power generation.

4619 **Directory of water heaters sorted by type and volume.** Sacramento, CA; California Energy Commission (1979). 59p. (NP—24140).

A list is presented of all the electric and gas-fueled water heaters that comply with California energy conservation regulations for appliances. Each water heater is listed with information on the manufacturer, brand name, model number, size, and rated input. (LCL)

4620 **Directory of consultants on the energy conservation standards for new buildings.** Sacramento, CA; California Energy Commission (1979). 29p. (NP—24045).

Comprehensive energy standards became effective on July 1, 1978 and are enforced by local building departments through the existing building permit process in California. To assist persons who must comply with the standards, the California Energy Commission (CEC) prepared design manuals for new residential and nonresidential buildings. The manuals contain explanations, sample calculations, reference materials, and the compliance forms submitted to the local building departments. As part of its continuing effort to help the building industry implement the standards, CEC staff has compiled this directory of consultants and consulting firms available to assist in preparing compliance documentation.

4621 **California Energy Commission Committee report relating to amendments to the appliance efficiency regulations concerning refrigerators, refrigerator-freezers, and freezers.** Sacramento, CA; California Energy Commission (1979). 13p. (NP—24155).

On November 3, 1976, the California Energy Commission adopted regulations setting appliance efficiency standards for refrigerators, refrigerator-freezers, and freezers. Subsequent to adoption of these regulations the Federal government has taken various actions which warrant modification of the Energy Commission's Regulations. The report describes the Federal government's involvement in improving the efficiency of appliances and recommends some minor revisions to the Commission's appliance efficiency regulations to make them consistent with the Federal actions.

4622 **Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives.** Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978). 538p. (CONF-770818—P1). The Publisher, 1025 Vermon Avenue, NW, Washington, DC 20005.

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Forty-five papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

4623 Energy conservation in heating and cooling of buildings. Hoogendoorn, C.J. (Tech. Univ. of Delft, Netherlands). pp 1-12 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The need of conserving our primary energy resources has led to an increased awareness of the need of energy savings in heating of buildings. Effects should be made to minimize the use of primary energy, within the constraints of human comfort, economics and architectural design. Many factors play a role in the energy requirements for heating and cooling of buildings. Thermal factors influence the transmission and ventilation losses. These losses will depend on the micro-meteorological conditions outside the building. Temperature control in rooms together with the thermal transient behaviour of a building can be quite important. Different technical factors can lead to energy savings, of course better insulation, but also the use of district heating and heat pumps. Solar loads are important both for cooling and heating of buildings. The application of solar heating to save on primary energy resources finds widespread interest nowadays. To evaluate the effects of the many factors that play a role mathematical modelling of the thermal behaviour of buildings is a very fruitful tool. Coupled to hourly micro-meteorological data optimization studies can easily be made. From the same study it can also be concluded that energy savings of 33% could easily be obtained by better insulation techniques. Finally it is stressed that in an early stage of studies on new urban developments a thermal urban planning should be done. These studies should include all new energy saving techniques together with a thermal evaluation of new architectural designs. Realization of the goal of energy conservation will require cooperation of architects, engineers, and scientists.

4624 Economically optimal heat protection in buildings. Gertis, K. (Institut fuer Bauphysik, Stuttgart, Germany). pp 15-24 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

During the coming decades the energy supply will be tight and an economical use of energy will be necessary. This will be especially true in building construction, since appropriately 1/3 of the total energy needed in the Federal Republic of Germany is consumed via the exterior walls. Appropriate energy saving measures in the building sector would therefore contribute significantly towards easing this country's dependence on energy imports. Methods for calculating the cost of constructing walls with optimal thermal resistance and of determining the return on the investment, in terms of energy savings, for such construction are discussed. (LCL)

4625 Finite element analysis of heat and mass transfer in buildings. Comini, G. (Univ., Trieste, Italy); Del Giudice, S. pp 25-36 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The finite element method is used for the solution of two-dimensional heat and mass transfer problems in buildings. The versatility of this technique results in a viable method of solution for practical applications of the Luikov system of equations. Examples presented include heat and mass transfer in the foundation basement of a cold store, moisture movement in porous walls and a direct solution of quasi-stationary heat conduction problems in building components.

4626 Thermal resistance of structural members under unsteady conditions. Kuznetsov, Yu.N. pp 37-44 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The method for constructing formulas for calculating thermal resistance of structural members under unsteady conditions has been proposed. For a number of practical cases some design formulas have been presented.

4627 Simultaneous heat and moisture transfer in porous wall and analysis of internal condensation. Matsumoto, M. (Kobe Univ., Japan). pp 45-58 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The development of mathematic models of transient heat and mass transfer in a porous body of building are presented. System of this media is considered to be homogeneous multicomponent two phase heterogeneous mixture. Balance and constitutive equations are derived based on irreversible thermodynamics. Using these equations dynamics of internal condensation process are analyzed and compared with experimental results. The analytical results show good agreement with the experimental results.

4628 Fundamentals of moisture and energy flow in capillary-porous building materials. Claesson, J. (Univ. of Lund, Sweden). pp 59-69 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Basic physical features of combined energy and moisture flow in porous building materials for dynamic and stationary processes are discussed. The mathematical and physical structure of these dynamic processes is discussed in terms of local thermodynamical equilibrium, flows induced by gradients in intensive state variables, and conservation of energy, moisture and other components. The conditions for thermodynamical equilibrium in a capillary-porous material containing moisture in liquid and gas phases, air, and possibly salts in the pores are presented as a prerequisite for the understanding of the dynamic flow processes. The peculiarities of pore-water tension are discussed. Moisture may flow in gas phases and in liquid phases while interacting in a complicated way. The specific problems arising from the complex character of the flow are discussed. The relation between the moisture flow and gradients in intensive state variables such as pore-water pressure or tension, vapor pressure, gas pressure and temperature is discussed. Some problems concerning the energy flow are discussed. The energy flow is complicated by the mass flow in the pores. Divisions of the energy flow into heat flow and energy transfer due to mass flow and the effects of condensation and evaporation are discussed. The equilibrium relations and the transfer coefficients for porous materials often exhibit rather pronounced hysteresis. The causes of hysteresis and the complications due to hysteresis in the description, are dealt with.

4629 Moisture transfer in porous medium under a temperature gradient. Gupta, J.P. (Indian Inst. of Tech., Kanpur); Churchill, S.W. pp 71-81 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Most places on earth undergo diurnal as well as seasonal temperature changes. Besides, the internal heating and cooling of the buildings in cold and hot weather also results in temperature variation across the walls of the building. These temperature changes result in the movement of moisture in the soil and the building materials which can be significant when sub-freezing temperatures are encountered. Since this can affect the structural properties of the building material and its foundations, it is important to understand the mechanism of the moisture due to vapour pressure gradient is briefly presented along with on based upon the surface tension gradient in the liquid. Both models, though widely apart in concept, give order of magnitude results. It is difficult to reject either model based upon the present results. More specific experiments need to be done to decide between the two models.

4630 Engineering system for determining thermal and moisture transfer properties of structural materials. Shaw, A. (Univ. of Adelaide, Australia). pp 83-92 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The materials used in building design are an important determining factor of the capital and energy costs of heating and cooling buildings. A laboratory chamber for the study of the thermal and moisture transfer properties of structural materials is proposed. The purpose of the design is to simulate both the inside and outside temperature and humidity on the two sides of a test panel of structural material to be analyzed. Any desired inside pair and any desired outside pair of temperature-humidity conditions over a wide climatic range can be investigated. The system can accommodate

most structural materials from a glass sheet to a concrete wall. A unique low energy inexpensive engineering system is described which will obtain results to close tolerances.

4631 Effects of infiltration on heat transfer through vertical slot porous insulation. Burns, P.J.; Tien, C.L. (Univ. of California, Berkeley). pp 93-105 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Results are reported of an analytical investigation of convective heat transfer through vertical slot porous insulation with infiltration. The objective is to understand the effect of infiltration upon the heat transfer characteristics of building-wall insulation. An equivalent porous covering material is used to simulate porous openings, holes or cracks. The influence of the modified Rayleigh number, the size and location of the opening, the infiltration due to wind pressures, and the pertinent parameters characterizing the covering material is analyzed. It is demonstrated that infiltration may significantly increase the heat transfer through vertical slot porous insulation.

4632 Effect of convective heat exchange on thermal-insulating properties of permeable porous interlayers. Brailovskaya, V.A.; Petrazhitsky, G.B.; Polezhaev, V.I. (Moscow High Technical School, USSR). pp 107-113 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A mathematical model is presented of stationary two-dimensional thermal convection in a finely divided medium with fine pores. Calculations are carried out for various convection conditions at Rayleigh numbers from 10 to 1000, and considering annulus-shaped cross sections of porous materials with the ratio of external to internal radii from 1.01 to 8.0. The results quantify the effects of convection on the thermal properties of porous materials, and should be useful in choosing methods for suppressing such convection. (LCL)

4633 Radiative energy transfer effects on fibrous insulating materials. Oezil, E. (Middle East Technical Univ., Ankara, Turkey); Birkebak, R. pp 115-124 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The results of an experimental study are presented and correlated with a theoretical model for the combined modes of heat transfer through a fibrous insulating material. The study involves the effects of environmental thermal radiation exchange on the heat transfer in a fibrous insulating material which has one free and one bounded surface. Such conditions are found for insulation used in attics of houses. Experimental results are presented in terms of temperature profiles and net radiative heat flux in the fibrous material as a function of environmental radiation temperature, air temperature, base or substrate temperature and base heating rate.

4634 Analysis of heat transfer through walls with vertical air layers and wall leakage. Bystrov, V.; Galaktionov, V. (Moscow Power Engineering Inst., USSR). pp 125-132 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Heat transfer from the warm air to the cold one across the vertical air layer is considered under mixed natural-forced convection. Correlations between heat transfer coefficients and constructive characteristics, conditions of heat transfer from the side of the warm and cold air, a value of the leakaging air are obtained by means of a numerical solution of the system of equations.

4635 Ventilation of buildings: a review with emphasis on the effects of wind. Wise, A.F.E. (Dept. of the Environment, London, England). pp 135-153 of Energy conservation in heating, cooling, and ventilating buildings, heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

In this review of ventilation, particular attention is given to the natural ventilation of housing in which wind is the dominant force. Meteorological data in a form of presentation used in the UK are outlined. Air movement around buildings is described as a basis for information on wind pressure distributions. A simple theoretical treatment indicates when buoyancy may be more important than wind in determining ventilation rates; and ventilation in practice is discussed with reference to physical principles and human factors. Research needs are emphasized in a final discussion.

4636 Human discomfort in indoor environments due to local heating or cooling of the body. Fanger, P.O. (Tech. Univ. of Denmark, Lyngby). pp 155-163 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Due to comprehensive research over the last ten years it is possible today to predict those combinations of the environmental parameters (air temperature, mean radiant temperature, air velocity and humidity) which will provide thermal neutrality for man at a given activity and clothing. However, thermal neutrality for the body in general is not always sufficient to provide thermal comfort for man. It is a further requirement that no discomfort is created due to local heating or cooling of the body. This may be caused by an asymmetric radiant field, a local convective cooling of the body (draught), by contract with a warm or cool floor or by a vertical air temperature gradient. Recent research on discomfort due to local heating or cooling of the body is reviewed. Limits for avoiding local discomfort are established and discussed.

4637 Natural ventilation in well-insulated houses. Nevrala, D.J.; Etheridge, D.W. (British Gas Corp., London, England). pp 165-178 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An analysis is presented of the mechanics of natural ventilation, and a computer program for predicting ventilation patterns in houses is described. Results of computer-based simulations of the thermal behavior of a well-insulated dwelling are presented. This study resulted in the following conclusions. When estimating the overall air supply to dwellings, allowance should be made for air infiltration through background leakage areas, such as cracks around doors and windows. Present day design procedures for estimating ventilation rates do not consider background leakage areas and consequently these procedures are likely to underestimate ventilation heat losses. Large variations in ventilation heat losses, and hence total heat requirement can occur as a result of variation in wind speed and direction. This could lead to problems in sizing the heaters for well-insulated dwellings. In addition, a problem is likely to occur in sizing the heat emitters of the individual rooms, as a result of the wide range of infiltration routes of the ventilation air. One solution to this problem might be the adoption of individual room temperature control. Careful consideration should be given to ventilation phenomena when designing space heating systems for well-insulated dwellings. It is believed that prediction methods, such as that described here, will be useful for predicting general trends and also possible for application to specific types of dwelling.

4638 Ventilation of flats. Truemper, H.; Bley, H. (Univ., Karlsruhe, Germany). pp 179-188 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The design of ventilating systems for apartment buildings, and the contribution of these systems to energy conservation and occupant comfort are discussed. (LCL)

4639 Ventilation through openings on one wall only. Warren, P.R. (Building Research Establishment, Garston, England). pp 189-206 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The main mechanisms giving rise to the natural ventilation of spaces with openings to outside air in one wall only are reviewed. Expressions which enable the magnitude of the ventilation rates due to each of these mechanisms to be calculated are derived from theoretical and wind tunnel studies. The results of measurements on a full-scale building are reported and compared with predictions.

4640 Prevention of unwanted airflow between areas having different hygienic standards in hospitals. Esdorn, H.; Giese, K.; Schmidt, M. (Univ., Berlin, Germany). pp 207-218 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass

transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An experimental and analytical investigation of ventilation systems for the reduction of airborne contaminants transmitted between hospital areas with differing hygenic standards is described. This system relies upon air lock chambers between areas to block the flow of contaminants. Performance tests showed that single-chamber air locks can protect pressurized clean areas from contamination. Multiple-chamber air locks should be used if maintenance of positive pressure in the clean area is not obtainable. (LCL)

4641 Heat and mass transfer of internal surfaces in guarding constructions. Brdlick, P.M. (Moscow Tech. Inst. for Forestry, USSR). pp 219-229 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The calculation reliability of exterior wall construction thermal resistance is determined by the accuracy of the heat transfer coefficient calculations for internal surfaces. The internal aerodynamic regime of buildings depends on the functional purpose. In dwellings the natural convection regime is realized, but in the most industrial plants and housing for livestock, mixed convection appears.

4642 Heat transfer in buildings with panel heating. Martynenko, O.G.; Sokovishin, Yu.A. (Heat and Mass Transfer Inst., Minsk, USSR). pp 231-244 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The heat transfer of a vertical electrically heated surface is investigated. An analysis is made of the effect of Gr and Re numbers on heat transfer in buildings at free and mixed convection. Criterial formulas are given for calculation of heat transfer in a wide range of basic parameters. The effect of cocurrent and countercurrent flows is shown.

4643 Airflow in a room as induced by natural convection streams. Euser, H.; Hoogendoorn, C.J.; Van Ooijen, H. (Tech. Univ. of Delft, Netherlands). pp 259-270 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An experimental study is presented describing the air flow in a room induced by natural convection streams both in a full scale climate chamber and in a 1 to 10 scale-model. The air flows have been investigated. The flow was characterized by the angle under which the cold downdraught of the window and the rising warm air from the radiator placed below it, flows into the room after mixing. The angle appeared to be a function of the ratio of the heat contents of both flows. The measured heat flow for the laminar boundary layers agreed well with literature data, but for the turbulent case there were substantial differences. In particular the measured velocity profile differed from data of Cheesewright. The effects on the angle caused by the form and size of the window sill and the use of glass curtains could be predicted qualitatively from the model experiments.

4644 Fundamentals of building heat transfer. Kusuda, T. (National Bureau of Standards, Washington, DC). pp 321-338 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Basic problems and unique features of building heat transfer are described in relation to the heating and cooling load calculation, which is a starting point for building energy consumption analysis and equipment sizing. Detailed discussion is given of the relationship between heat loss (heat gain) and heating load (cooling load). Also outlined is a discussion of the multi-space heat transfer problem in which the air and heat exchange equations among adjacent spaces in a building are solved simultaneously with the radiant heat exchange equations for the surfaces of each room.

4645 Perspective methods of numerical solution of free-convection problems for buildings. Berkovsky, B.M.; Nogotov, E.F. (Heat and Mass Transfer Inst., Minsk, USSR). pp 361-368 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Two finite difference schemes designed for solution of problems on free convection in enclosed regions are considered. Both schemes allow calculations over a wide range of process parameters, give accurate display of local and integral heat transfer characteristics and possess high speed of convergence. The methods of automatic choice of the optimum time step size providing the highest speed of convergence in solution of unsteady-state problems are described.

4646 Unified approach to mass and heat transfer calculations in enclosures. Davies, M.G. (Univ. of Liverpool, England). pp 369-377 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A procedure frequently used in the UK for the design of heating and cooling systems and estimating the response of the fabric of a building, is based on a combination of air and radiant temperature, called environmental temperature, rather than air temperature alone. The key features of this procedure and how it can be extended to include the effect of step changes in thermal excitation, and to include moisture movement in an enclosure are discussed.

4647 Digital comuputer program for the calculation of yearly room energy demands and temperature exceeding rates, using hourly weather data. Nicolaas, H.J.; Knorr, K.T.; Euser, P. (Inst. of Applied Physics TNO-TH, Delft, Netherlands). pp 379-391 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A computer program for the calculation of the indoor temperatures, temperature exceeding rates, the design heating and cooling loads, and the yearly heating and cooling demands in the rooms of a building is described. The program is based on a thermal response factor method. The response factors are determined by means of a program in which the equations for the heat transfer processes in the room are solved by an implicit differential method. Comparable results obtained by other methods are given.

4648 Functional modelling of room temperature responses and the effects of thermostat characteristics on room temperature control. Letherman, K.M. (Inst. of Science and Tech., Manchester, England). pp 393-404 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A digital simulation was performed on a number of simple rooms to compute the response of the air temperature and the surface temperature to a step input of heat. The step responses were thus obtained in numerical form. A suitable form of Laplace transfer function was obtained empirically to give an accurate functional representation of the responses. The numerical and functional representations of the responses are compared. The control characteristics of an on-off room thermostat are then combined with each room response function and the controlled cycling characteristics of the combination of thermostat and room are computed. The effects of the sensing properties of the thermostat and of the dynamic responses of the thermostat and heating plant are examined and compared.

4649 Method for calculating the thermal load on air-conditioned buildings. Hassan, K.E. (Arab Development Inst., Tripoli, Libya); Zaki, G.M. pp 405-418 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A mathematical method to predict the thermal effect of a building component is presented. Dimensionless groups are used to give generality to the solution obtained in the sense that it could be used for various building materials and localities. The method separates the effect of outside air temperature from that of solar radiation, a feature that adds to the flexibility and generality of a solution. It also gives, as the steady-state part of the solution, the average load on the air conditioning unit and, therefore, an indication of the total energy required. Further, the solution gives general

mathematical expressions that could be used directly for any special case that may be encountered, without need for re-solving the problem.

4650 Method for calculation of thermal behaviour of buildings. Hauser, G. pp 419-427 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A method for calculating the thermal behavior of buildings of any size, form, structure as well as any thermal charge from outside and inside is being presented. All thermal processes within buildings can be handled by calculation of room temperature or energy consumption and handling of regulating processes containing the transition from calculations of room temperature to calculations of energy consumption and vice versa. After a brief description of the mathematical method the application possibilities of the method are explained. Confrontation of measured and calculated indoor air temperature cycles of different buildings serves for demonstration.

4651 Energy conservation in new buildings. Adamson, B.; Kaellblad, K. (Lund Inst. of Tech., Sweden). pp 429-438 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Different methods for calculating the heat consumption in buildings are discussed in brief. Studies have been carried out on the way different factors such as window size, facade orientation etc. influence energy consumption in buildings. The risk of obtaining undesirably high indoor temperatures when designing buildings with extremely low energy consumption is discussed.

4652 Influence of the outdoor temperature variation on the performance of a building heating system. Carrara, C. (Italsider, Gruppo Ricerca Operativa, Genova, Italy); Fantini, L.; Lorenzi, A. pp 439-447 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The combined influence of the outdoor temperature variations and structural characteristics of a building in investigated with reference to heating system performance. The study is performed employing a simulation procedure. The outdoor temperature variations, considered in the calculations, are derived from a particular statistical analysis of real values referred to the zone considered (Genova-Italy). The results of this investigation allow the evaluation, in probabilistic form, of the optimum thermal design of buildings, in order to minimize the energy consumption and to get comfortable indoor temperature.

4653 Computer program "KLi". van der Bruggen, R.J.A.; Lammers, J.T.H. (Eindhoven Univ. of Tech., Netherlands). pp 449-463 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The heat balance of a room is represented by a number of second order Fourier equations for the various layers of the walls and first order differential equations for the boundary conditions of the walls. The method of Crank Nicholson is used for the numerical solution of the Fourier equation. The boundary conditions of the inside walls consist of two first order differential equations, one for the inside of the room and the other for the outside of the room. These two equations are used, by an iteration process, for coupling neighbouring rooms. The computer program is made in a conversational mode.

4654 Application of the digital computer to evaluate energy conservation options in building air conditioning based on temperature deviation from design. Iqbal, A.; Newlin, J.K.; Fish, P.R. (Atkins Research and Development, Epsom, England). pp 465-475 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The use of computers in building air conditioning heat transfer calculations is now well established, and we have come a long way from the time when the computer was used simply to crunch numbers of total building heat gains. Today, the use of computers is opening up many new and interesting avenues for practicing engineers. With the added incentive to conserve energy, studies are now being carried out which would have been inconceivable without a computer. One such set of studies is discussed in which the impact of allowing the temperature to swing has been quantified and the many ways it can be used to conserve energy in buildings described. Computer programs have been developed with the aim of getting a better understanding of building heat transfer and consequently the energy behaviour due to the interaction of weather, building characteristics, plant characteristics and control systems. This work has culminated in a Fortran package, the starting point of which is a conventional cooling load calculating program. The loads output by this program form the input to the family of programs one of which is described here.

4655 Thermal dynamics of a building represented by response functions. Soeleman, R.S. (TNO Research Inst. for Environmental Hygiene, Delft, Netherlands). pp 477-482 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Computing methods based on the use of a system modeling program can be expensive for energy consumption analyses as a consequence of computing time. The introduction of the transfer function (in this case the impulse response function) concept could remedy this. A concise description is given regarding the seasonal heat consumption of a dwelling. Computed figures are the result of a computer program executed by means of the response functions of the simulated dwelling system. With simple statistical methods a comparison has been made between calculated values and actual readings.

4656 Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978). 360p. (CONF-770818—P2). The Publisher, 1025 Vermon Avenue, NW, Washington, DC 20005.

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Twenty-nine papers were presented at the meeting. A separate abstract was prepared for each of 28 papers. One paper appeared previously in Energy Research Abstracts. (LCL)

4657 Heat storage in buildings: an overview. Givoni, B. (Ben-Gurion Univ., Beersheba, Israel). pp 559-572 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Methods of heat storage in buildings and its effect on thermal performance, human comfort and energy consumption of air-conditioned and non-conditioned buildings are discussed. The role of heat storage in buildings heated and cooled by solar and other renewable natural energies is analyzed in relation to different types of buildings.

4658 Domesitc heat pumps for heating only. Blundell, C.J. (Electricity Council Research Centre, Capenhurst, England). pp 573-581 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

In North European countries there are few houses that require summer cooling, and so a domestic, air-to-air heat pump does not have to fill two roles. Choice of a capillary for refrigerant control, electric resistance defrost, suitably controlled, and heat exchangers sized to give maximum efficiency in the heating cycle, give a considerable improvement in heating performance, and a reduction in capital costs, compared with units designed for heating and cooling. Evaporator and condenser sizes must be decided from an economic optimization. Experimentally verified calculations show that an improvement in seasonal coefficient of performance from about 2 (a value typical of present units) to about 3, may be obtained. The heat pump test facility used in this work consisted of two separate spaces, each with its airflow temperature controlled and monitored, so that the performance of a heat pump, operating between the two spaces, could be deduced.

4659 Laboratory investigation of a Stirling engine-driven heat pump. Didion, D. (National Bureau of Standards, Wasington, DC); Maxwell, B.; Ward, D. pp 583-596 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

An experimental investigation was conducted on an air-to-air heat pump powered by a single-cylinder, seven-horsepower, water-cooled Stirling engine. The steady-state part-load performance of the engine-driven heat pump system was determined in both the heating and cooling modes of operation. The unit was operated over a broad range of outdoor temperatures and corresponding coefficients of performance (COP), and seasonal performance factors (SPF) were determined. The energy rejected to the engine's cooling water was measured and included in the heating mode calculations.

4660 Heat and cooling supply of buildings in coastal zones. Vezirishvili, O.Sh.; Khachaturian, R.A. pp 605-612 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A novel system of heat and cold supply of the buildings in the coastal zone is described that employs heat pump units utilizing the heat of sea water. Results are presented of experimental and power-economical research which have proved the high efficiency of the system.

4661 Design of low cost ventilation air heat exchangers. Besant, R.W.; Brooks, E.E.; Schoenau, G.J.; Dumont, R.S. (Univ. of Saskatchewan, Saskatoon). pp 613-620 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The design of a low cost ventilation air heat exchanger proposed which utilizes plastic sheets as the heat transfer surface is presented. Laboratory tests on such a counter flow heat exchanger have demonstrated very high values of overall heat transfer coefficients, heat exchanger effectiveness, and temperature when the flow is laminar and buoyancy effects assist the heat transfer. The costs of such heat exchangers would make them attractive for many building applications.

4662 Radiant cooling and comfort with high ambient air temperatures. Montgomery, S.R.; Hart, S. (University Coll. London, England). pp 621-627 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The place of radiation in providing comfort conditions without the additional need to reduce the ambient air temperature in an occupied space is discussed and details are given of radiant cooling panels designed to operate with surface temperatures lower than the ambient dew point temperature. Experimental data on full scale panels provides information on the relative merits of various designs.

4663 Heat storage and transient temperature distribution in three-dimensional composite solid systems. Pleiss, J. (G. Bauknecht GmbH, Stuttgart, Germany); Hahne, E. pp 661-669 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Conventional calculations of heat losses and temperature fields are based on one-dimensional heat flow. This is realistic for parts of a wall area. For edge and corner sections, however, the heat flow is two- and three-dimensional. Solutions to such problems are based on Newman's Rule (multiplicative superposition) and can be found in literature, provided that the systems are isotropic and homogeneous. In many cases only the solution for transient temperature fields is given. It is shown here that Newman's Rule can successfully be applied for the prediction of both transient temperature fields and heat losses of both homogeneous and composite solid systems. The application to composite systems requires the introduction of an equivalent Biot-and Fourier-number. With these equivalent numbers existing diagrams for one-dimensional temperature fields can be used. The method was checked by numerical calculation with good agreement. For a practical example experimental measurements were taken on a storage radiator and compared to the numerical calculation.

4664 Study of temperature conditions of heated floor structures and building foundation soils with negative temperature of internal media. Gindoyan, A.G.; Grushko, V.Ya. (TSNIIpromzdaniy, Moscow, USSR). pp 671-682 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A mathematical model of heat and mass transfer processes in the floor structures and building foundation soils with negative temperatures of internal atmosphere is presented. The thermal interrelation of a building and foundation soil (non-stationary case) has been considered. The zones with steady and non-steady temperatures mode of floors and foundation soils have been determined. The variation task has been set to determine the power of a soil heating system and the solution of this task is given for a portion of an area with a heat conducting insert in the shape of column.

4665 (LIB-tr—4766) Decree of 11th August 1977 governing the use of energy-saving heating systems in buildings. Translated from *Bundesgesetzblatt, Teil I;* No. 56, 1553-1564(17 Aug 1977). 22p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Regulations adopted in the Federal Republic of Germany to minimize heat losses in buildings are itemized. Building codes for windows, doors, thermal insulation, and wall, floor, and ceiling construction are included. (LCL)

4666 (LIB-tr—4650) Energy saving and furnace installations. Vermoere, J. Translated from *Chal. Clim.;* No. 480, 15-17(Jan 1976). 7p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Furnaces operating with an open flue have shutdown losses, i.e., heat losses through the chimney draft when the burner is shutdown. A flue gas control valve which closes the flue during shutdown is described, and the annual fuel saving that can result from use of this device is calculated. It is estimated that shutdown loss can result in a fuel consumption increase of 20% or more. (LCL)

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 4318, 4319, 4322, 4588, 4590, 4592

4667 (DOE/EIA—0136) All electric homes. Annual bills: January 1, 1978, cities of 50,000 and more. Energy data report. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1978. 30p. NTIS, MF A01.

Information is presented on the average annual costs to residential consumers for representative amounts of electricity used exclusively for all domestic purposes. Average annual electric bills, average charges per kilowatt-hour and average kilowatt-hour consumption in all-electric homes are shown on a nationwide basis and for each state and individual communities throughout the United States.

4668 (DOE/EIA—0193/P) Preliminary conservation tables from the National Interim Energy Consumption Survey. (Department of Energy, Washington, DC (USA). Energy Information Administration). 1 Aug 1979. 71p. Dep. NTIS, PC A04/MF A01.

Preliminary data on the conservation activities performed by households since January 1977, and the status of households with respect to insulation, storm windows, and other energy-conserving characteristics, are presented. The report consists of four sets of conservation related tables. The first set presents statistics on the presence of storm windows and doors and insulation in the housing inventory for the winter of 1978 to 1979. The remaining three sets of tables are concerned with conservation additions made during three time periods: April 1977 to December 1978 (the period of eligibility for a 1978 energy tax credit); and the two calendar years of 1977 and 1978. Conservation inventories and additions are crossed by: census region, type of heating fuel, weather zones, type of building structure, year house built, type and presence of air conditioning, family income, and value of residence. The tables will be reissued in final form in the fall of 1979. (MCW)

4669 (DOE/TIC—10264) Residential energy consumption survey: interim report on study design and pretests. Draft. (Response Analysis Corp., Princeton, NJ (USA)). 15 Sep 1978. Contract EM-77-C-01-8568. 352p. Dep. NTIS, PC A16/MF A01.

The survey provides data to describe and monitor the way energy is consumed by households. The DOE needs established for the first survey are for a total sample of 12,500 households and a reinterview sample of 500 households. The integrated efforts include: household interviews to collect data on space-conditioning equipment, water heater, appliance checks, household vehicle stock and usage, selected physical characteristics of the housing unit, and household composition and socio-economic characteristics; utility company survey to obtain accurate information on household consumption of electricity, natural gas, fuel oil, and LPG; a household vehicle panel to provide accurate data on mileage driven, fuel consumption, and changes in vehicle stock for a 12-month period; and an energy-assessment procedure to include measurements of the physical charcteristics of the housing unit. Plans are presented for

data collection, draft questionnaire, and other data-collection forms and preliminary sample designs. This historical report provides a record of the methodological development to this stage and provides background for additional work to be undertaken. (MCW)

4670 (EDM—1107) **Labeling and advertising of home insulation. Final staff report to the Federal Trade Commission and proposed trade regulation rule (16 CFR Part 460).** (Federal Trade Commission, Washington, DC (USA). Bureau of Consumer Protection). Jul 1978. 331p. Federal Trade Commission, Bureau of Consumer Protection, Washington, DC.

Insulation can save significant amounts of fuel and money, and has therefore captured public attention as a desirable energy conservation measure. Because insulation is a very difficult product for uninformed consumers to evaluate, there was broad support for a rule requiring the disclosure of information facilitating choices among insulation products. With the information that the Recommended Rule will require, consumers will be able to compare the thermal properties of varous types of insulation and make the best purchases for their needs. In order to provide consumers, as quickly as possible, with information aiding their purchase of this major conservation measure, and to protect consumers from the abuses that rising demand has brought, the Commission undertook this rulemaking proceeding on an expedited schedule. The Rule was proposed on November 18, 1977. The tests mandated by the Rule will provide reproducible and accurate R-values, permitting comparisons of thermal performance. As a result of the testing and required disclosures of R-values and related information, consumers should be able to make sound choices for their needs, without being uninformed or misinformed about the relative values of different types of insulation. The Recommended Rule covers the testing, advertising, and labeling of thermal insulation products. It includes organic, fibrous, cellular, and reflective insulations sold for use in homes, apartments, and other residential dwellings. Insulation sold directly to consumers for do-it-yourself installation is covered, as well as insulation installed by professionals.

4671 (HIT—650-11) **Residential energy consumption detailed geographical analysis. Summary report.** Alereza, T. (Hittman Associates, Inc., Columbia, MD (USA)). May 1977. 55p. Hittman Association, Inc., Columbia, MD.

Data are presented on residential energy consumption in single-family and multi-family housing in 11 cities across the US. The characteristic buildings, their heating and cooling loads and the resulting energy use are described, and the potential energy savings associated with a set of improvements made to each building are discussed. (LCL)

4672 (NP—24128) **Domestic heating with heat pump systems.** Thiel, G.H. (Verein Deutscher Ingenieure, Duesseldorf (Germany, F.R.). Gesellschaft Bildungswerk). 1978. 34p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

After an introduction to the fundamentals of the use of different energy sources for heat pumps and an evaluation, the constructional physics requirements to minimize the heat demand are outlined. The advantages and disadvantages of various heating systems with heat pumps are explained. Examples of a heat balance are a single-family house with a swimming pool and a swimming pool as a specific problem. Finally, the possibilities of heat pump control are discussed.

4673 (SIB-R—8-1979) **Cost-benefit analysis of thermal insulation of houses.** Sjoelund, J. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1979. 52p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

How the most effective thermal insulation of a house should be dimensioned, with respect to construction and energy costs is discussed. It is shown that the current Swedish Building Code, SBN 75, does not give the most cost-effective result.

4674 Study of ventilation efficiency in an experimental room: thermal comfort and decontamination. Laret, L.; Lebrun, J.; Marret, D.; Nusgens, P. (Univ., Liege, Belgium). pp 245-257 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The present study covers 75 tests performed in a climatic room representing a heated dwelling room. The tests on the comfort involve measurments of the air velocity in the ventilation jet and in the occupied zone. The results of these tests show that it is necessary to increase the supply velocity as the corresponding temperature is lowered, in order to avoid a fall of the jet by buoyancy effect. In the tests on the ventilation efficiency one observes the response of the room to a brutal contamination by a tracer gas. Contamination tests indicate that the internal air mixing is nearly always perfect. This can be explained by the effect of natural convection induced by the heating source. For practical cases, one can thus suppose that these conditions of perfect mixing are well obtained.

4675 Seasonal operating performance of gas-fired hydronic heating systems with certain energy-saving features. Chi, J. (National Bureau of Standards, Washington, DC). pp 495-504 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

DEPAB (DEsign and Performance Analysis of Boilers) is an NBS computer program for simulation of fossil-fuel-fired boilers for residential heating systems. It is based upon an analytical model which accounts for cyclic (on-and-off) operation of a boiler fuel burner and water circulating pump. The use of DEPAB for evaluating quantitatively the effectiveness of several selected energy-saving features for gas-fired hydronic heating systems is illustrated. Sufficient information is also provided to demonstrate the important factors of the simulation program DEPAB.

4676 Moisture control in buildings: opportunities for a heat pump dehumidifier. Brundrett, G.W. (Electricity Council Research Centre, Capenhurst, England). pp 597-604 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Criteria for moisture control are reviewed. These vary from personal factors such as comfort and absence of electrostatic shock to mould growth which can insidiously attack the building fabric. Field studies on housing are examined to quantify the magnitude of the problem. These show that for a mild, damp climate such as Britain's the risk of condensation problems is large. These are avoided in practice by judicious manipulation of background heating and ventilation control. However the energy cost can be high. An alternative approach is proposed which first seeks to reject as much moisture from clothes drying and cooking at source. The bulk of the remaining moisture is then extracted by a heat pump dehumidifier. Performance curves are given for a typical unit.

4677 Heat flow into the ground under a house. Muncey, R.W.R.; Spencer, J.W. (CSIRO, Victoria, Australia). pp 649-660 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

In calculating non-steady heat flow within buildings, the assumption of one-dimensional heat flow is almost universal. However, this assumption is not acceptable for heat flow at the ground, especially for detached domestic buildings. A mathematical model which idealizes such a situation and determines a one-dimensional equivalent is presented. A temperature is represented by a Fourier series in two dimensions, suitably truncated to give a practical value of rate of change at the perimeter and under these conditions the average heat flow over the surface can be calculated. Conversely a similar pattern of heat flow permits calculation to be made of the average temperature. In practical situations there is always an air film resistance above the ground and a wall around the perimeter. The theory includes these effects. Under steady state conditions the ratio of heat flow to temperature can be used to estimate the U-value of the ground, which is shown to agree with experiment. As has been found empirically in the past, an approximate relationship exists between slab perimeter and ground thermal resistance. Evaluation of the ratio of heat flow to temperature at various frequencies enables the complex admittance parameter used in the matrix method to be estimated. It is shown that simple resistance-capacitance elements can represent the behaviour of the ground to sufficient accuracy. A method is given for assessing the values of the elements to represent widely differing types of ground.

4678 Equivalent degree-day concept for residential space heating analysis. Rogers, J.T.; Findlay, J.B.; Swinton, M.C.; Moizer, J.D.; Moll, R.H.H. (Carleton Univ., Ottawa, Ontario). pp 853-867 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A model has been developed to represent the residential space-heating demand in Ontario, so as to permit better forecasting of energy consumption in this sector and the evaluation of various policy options. The Ontario housing stock is represented by four typical residences whose structural and thermal characteristics were

established by an extensive survey. To provide the accuracy desired, the conventional degree-day method is replaced by the equivalent degree-day method, which allows for passive solar heat and for wild heat. Typical results obtained by use of the model are given.

4679 (LIB-tr—4648) **New developments in gas appliances for cooking, water heating, and space heating.** Joos, L.; Van Heyden, L. Translated from *Gas- Wasserfach;* **119**: No. 3, 111-118(1978). 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This paper discusses: gas cooker with Gas-CERAN radiant surface, EE standard natural gas setting, hot water heaters, exterior-wall appliances with fan, radiators, absorption heat pumps, modified U-Duct system, and energy conservation. (DLC)

4680 (LIB-tr—4456) **Improving efficiency and heat recuperation. Report No. 2.** Faudier, M.P. (Gaz de France, 75 - Paris). 24 Oct 1977. Translation of CERUG-E-PFa/SGa—77-871. 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The energy conservation achievable by the proper design, operation, and maintenance of natural gas-fueled home heating systems and hot water heaters and by the use of heat recovery systems is discussed. (LCL)

4681 (OA-tr—2160) **Use of the heat pump for heating dwellings with heat drawn from the soil.** Schaer, O. Translated from *Bull. Schweiz. Elektrotech. Ver.;* **68**: No. 4, 182-184(19 Feb 1977). 7p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The heat pump with soil as the heat source offers the possibility of heating small dwellings. The design of a suitable heat pump with associated buffer storage is briefly presented. The thermal behaviour of the ground when heat is drawn from it is investigated and measurements are reported.

4682 (PSA-tr—684) **How much energy does a house need.** Fueeg, F.; Haller, F. Translated from *Bauen Wohnen;* **30**: No. 6, 231-234(Jun 1976). 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Experimental data on the energy consumption in houses in Switzerland are used to refute claims, based on laboratory and theoretical data, that houses with large glass areas consume more energy than houses with smaller window areas. The importance of overall design and construction features, building orientation, and building operation on home energy consumption is discussed. Energy accounting for a building considering the total energy consumed for producing, maintaining, operating, and demolishing a building is described. (LCL)

4683 (OA-tr—1487) **Heating requirements in small houses.** Munther, K.E. Translated from *VVS - Tidskr. Vaerme-, Vent.-, Sanit.-Kyltetek.;* **45**: No. 1, 28-32(Jan 1974). 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The investigation described was intended to obtain accurate measurements of the energy consumption in small houses constructed in the normal way, and to establish how these measurements are affected by various factors. It should be useful, particularly from the point of view of national economy, to obtain a series of empirical values which can be applied to the planning of new buildings, when climatic conditions and other factors which affect the energy balance have been taken into consideration. An examination was made of 5500 occupied houses of various types and geographical locations and the measured results were compared with the theoretical expectations. The window surface area, amount of ventilation, and the amount of central heating were measured along with any other factors which could affect the energy consumption. The consumption values, obtained on the basis of the true mean monthly temperatures during the period of the investigation, were compared and adjusted, firstly according to the normal annual temperatures for the area, and secondly according to the climate in Stockholm.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 4589

4684 **Calculation of energy consumption of a building by computer simulation.** van Paassen, A.H.C.; 'tHooft, E.N. (Delft Univ. of Tech., Netherlands). pp 483-494 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A computer simulation is made of the thermal behavior of an existing office building and its air conditioning system, a so-called variable volume system. The yearly energy consumption and the influence on energy consumption of the various properties of the building and its air conditioning system are calculated and discussed. To reduce computer time much attention is paid to the construction of compact mathematical models of the various components of the system without loss of accuracy. For example, the behavior of the building is calculated by means of the method of room response factors. To obtain a further reduction of computer time, a new approach of this calculation is suggested. A very simple calculation model is used to simulate the water cooler and the heat recovery system (twin coil system), which is derived from a complex model describing the physical behavior in detail.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 4589

4685 (AD-A—062434) **Sea/lake water cooling for Naval facilities. Final report November 1975-November 1977.** Ciani, J. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Sep 1978. 38p. NTIS PC A03/MF A01.

Seawater cooling was found to be economically feasible for a trial Naval facility in San Diego, Calif. and an operational test was recommended for the Naval Security Group Activity (NSGA), Winter Harbor, Maine. A preliminary design and environmental impact assessment were performed for a seawater cooling system at NSGA. This work was supplemented with seawater temperature measurements in the adjoining bay, a study of biofouling and its prevention in this system, and land and offshore surveys at NSGA. A separate study found that the life cycle cost of this seawater cooling system was less than that of the existing conventional air conditioning system. It was concluded that a seawater cooling system for NSGA would cost about $150K, and annually save over 200 MWh of energy and $9,000. Also, a study of the Navywide potential of sea/lake water cooling found that if such cooling were installed at 25 Navy sites, 59 x 1,000 MWh and $3 million could be saved annually. This report recommends that: (1) a final design and installation of an operational test seawater cooling system for NSGA, Winter Harbor be made; (2) seawater temperatures be measured at Apra Harbor, Pearl Harbor, Chicago, and Point Mugu as potential sites; and (3) a parametric model be developed for estimating the capital and energy costs of sea/lake water cooling systems.

4686 (AD-A—067161) **Infrared thermography of buildings: qualitative analysis of five buildings at Rickenbacker Air Force Base, columbus, ohio. Special report.** Munis, R.H.; Marshall, S.J. (Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Sep 1977. Contract MIPR-FQ46017073-0001. 26p. NTIS PC A03/MF A01.

A heat loss survey was performed on five typical Air Force Base buildings with an infrared camera system: two with wood frames and wood clapboards, one with wood frame and aluminum siding, and two of cinder block construction with brick veneer. A walk-through inspection was also performed on three of these buildings chosen by project monitors for retrofitting. This report presents thermograms typical of the heat loss problems in each of the five buildings along with a complete explanation of each thermogram. The purpose of the report is to serve as a basis upon which Air Force civil engineers can plan a future retrofit program for the buildings surveyed and write a set of specifications incorporating thermography. Typical thermograms show heat loss from large, single-pane, steel-frame, projected windows, which in one building account for 50% of the total wall area. Infiltration losses through framing spaces for all windows are evident. Heat patterns from precast concrete floor slabs and radiators under the windows showed up clearly. Ribs in uninsulated door panels were clearly seen as well as leakage around the doors. Heat loss through the roof of a one-story duplex was easily recorded from the ground using the infrared camera system. Thermographic comparisons between windows with storm sashes and a picture window insulating glass were made. Heat was found escaping from slab foundation vents and gable vents.

4687 (ILLDOE—79/11) **CBERS II: State of Illinois consolidated building energy reporting system instruction manual.** Ross, W.E. (Illinois Inst. of Natural Resources, Springfield (USA)). Jun 1979. Contract EU-78-G-01-4172. 47p. Dep. NTIS, PC A03/MF A01.

An instruction manual is presented for use by facility managers of state owned and operated buildings; and for facilities owned and operated by school and community college districts and local government buildings. This publication is for use in understanding and preparing monthly energy reports and evaluating computer printouts from the CBERS II computer program, which accepts monthly reports of quantities of fuels consumed, uses applicable Btu/Unit defaults to establish monthly Btu/ft^2 factors, recalls and compares previous month and same month/previous year, indicates % of increase or decrease, and also ranks units in terms of units reporting and their relative efficiency.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 4589, 4590

4688 Predictions of buoyancy influenced flow in ventilated industrial halls. Larsson, M. (Chalmers Univ. of Tech., Goeteborg, Sweden). pp 271-281 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

Numerical predictions of buoyancy influenced recirculating flow in a ventilated room are presented and comparison is made with experimental data. The flow is turbulent with steady, two-dimensional meanflow. The Archimedes numbers are chosen to be representative for industrial buildings. This means that the effects of buoyancy are strong enough to create a velocity field which shows very little resemblance to the isothermal velocity field in the same space. The calculations are made with the k-ϵ model of turbulence and the Boussinesque approximation is used for the buoyance influence. The boundary value treatment is discussed and a special wall function for heated or cooled vertical walls is presented.

4689 Porosity and the ventilation of animal housing. Pattie, D.R. (Univ. of Guelph, Ontario). pp 309-318 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

In areas where winter temperatures are often below -25° C, it is found that the insulated mechanically-ventilated building will not give satisfactory results. As the result of many years of research, experimentation, and observation it was concluded that, in these conditions, satisfactory results are obtained with porous type buildings.

4690 Heat transfer calculation for industrial enterprises. Motulevich, V.P. (Moscow Power Engineering Inst., USSR). pp 339-353 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A method for calculating the heating or cooling load for a room in an industrial plant is presented. Radiant and convective heat transfer within the space are considered. It is concluded that temperature distribution and heat transfer between some elements of industrial halls can be described by a closed system of equations whose solution may be done by present-day computers. The accuracy of the solutions obtained depends primarily on validity of the relations used for determining heat transfer between some elements. Theoretical and empirical relationships describing heat transfer intensity in classical idealized conditions may be greatly different from those which are valid inside the rooms due to the occurrence of different disturbing factors. To verify and sometimes to establish appropriate relationships it is necessary to carry out additional theoretical and experimental studies both using simulations and under conditions close to natural ones. It is desirable that data obtained on existing installations should be widely used since expenditures for conducting the experment itself are rather small compared to the cost of the premises where experiments are carried out. (LCL)

4691 Convolution principle as applied to building heat transfer problems, including fundamentals of efficient use. Lokmanhekim, M. (Univ. of California, Berkeley). pp 355-359 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

The major Energy Utilization Analysis of Buildings computer programs utilize the Convolution Principle to compute heat gain (loss is considered as negative heat gain) through a wall/roof; exterior surface temperature of a wall/roof, and the time delay between heat gain and a space resulting loads on the heating, ventilating and air conditioning system. A computation example is presented of the use of the Convolution Principle for calculating the heat gain into a building through the walls and roof. (LCL)

4692 Dynamic modeling of greenhouse climate, applied to greenhouse control. Bot, G.P.A.; van Dixhoorn, J.J.; Udink Ten Cate, A.J. (Agricultural Univ., Wageningen, Netherlands). pp 505-516 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

A systems approach to greenhouse modeling and control is outlined by presenting two types of dynamical models. The first type of modeling uses a simple black box model. This is updated by online estimation and is incorporated in an adaptive computer control system. Results of field trials are included. The second model is more elaborate and based on the heat and water vapour balances in the greenhouse, which are presented in bond graph notation. The application of these models in a hierarchical control system configuration is discussed.

4693 Economics of heat recovery systems for animal shelters. Larkin, B.S. (National Research Council, Ottawa); Turnbull, J.E. pp 527-538 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

In severe climates, livestock are kept in a building over the winter. Animals generate moisture and the building must be ventilated to control moisture. The heat required to heat the incoming air can be extracted from the exhaust air by a heat exchanger. The energy savings that result have been calculated for laying chickens housed in cages or growing-finishing pigs. The heat exchanger cannot always satisfy design requirements for the building during extremely cold weather but most farmers would accept short periods of substandard ventilation. In one of the cases considered the load factor of the system was low and the rate of return on investment was only average. In three cases with a higher load factor the savings were large.

TRANSPORTATION

4694 (NTIS/PS—79/0558) **Energy conservation: transportation. Volume 2. 1978-May, 1979 (a bibliography with abstracts). Report for 1978-May 79.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 75p. NTIS PC N01/MF N01.

The potential to achieve fuel conservation through technology, management, and planning is discussed. Transportation areas covered include urban mass transit, aviation, marine transportation, automobiles, trucks, and railroads. A few abstracts discuss public attitudes concerning conservation measures. (This updated bibliography contains 69 abstracts, 52 of which are new entries to the previous edition.)

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 4717, 4725, 4728

INDUSTRY AND AGRICULTURE

4695 (INKA-Conf—79-171-002) **Way to an industrial energy concept.** Ritter, C.F. (SAPCO G.m.b.H., Duesseldorf (Germany, F.R.)). 1979. 28p. (In German). (CONF-7906137—1). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Lecture meeting on optimized energy economy in industry; Essen, F.R. Germany (5 Jun 1979).

Optimization in the energy economy can only be realized by a detailed medium-term overall concept which comprises an energy conservation schedule with a detailed catalogue of measures and an energy control system as well as strategies to ensure energy supply to industrial undertakings. The eight steps required to realize the overall concept are discussed in great detail.

ENERGY SOURCES

4696 (AD-A—067165) **A plot study of the potential for Navy utilization of solid waste derived fuels to offset fossil fuels consumption. Final report.** Capps, A.G.; Duffey-Armstrong, M.; Freeman, R.E. (SRI International, Menlo Park, CA (USA)). Jun 1978. Contract N00014-76-C-0351. 37p. NTIS PC A03/MF A01.

A brief study was made to define problems that would be encountered in estimating potential Navy markets for various forms of waste derived fuels. Fossil fuel consumption estimates for boiler plants at several Navy activities were converted to waste derived fuel (WDF) estimates using a set of assumed rules judged technically feasible regarding boiler conversions and confirming fossil fuels and WDF. The results of this first study are presented indicating Navy boilers might represent a significant market for all the WDF a region could produce if the WDF were available in liquid as well as solid forms. The economic feasibility of conversions and WDF production are not addressed in this brief paper.

4697 (DOE/CS/2123—T1) **Computer technology can enhance industrial energy efficiency.** (Centec Consultants, Inc., Fort Lauderdale, FL (USA)). 1979. Contract EX-76-C-01-2123. 36p. Dep. NTIS, PC A03/MF A01.

Rapid escalation in energy costs since 1973 has increased operating costs and, in turn, caused a sharp rise in the prices of both consumer and industrial products. Reoptimizing manufacturing processes to account for higher energy costs is a formidable task and will strain the technical manpower of industrial communities. Analysis of a process will identify several technological or operating options that might decrease operating costs by improving energy efficiency and feedstock use. Each option must be carefully evaluated to achieve the maximum return on invested capital and manpower costs. Developments in computer technology have created tools with potential for energy conservation in the process industries comparable in some cases to the use of more energy-efficient process equipment. Some of the new developments are discussed. This report was written to familiarize the process industry manager with computer applications that have potential for minimizing energy consumption and to present an overview of the current level of computer technology and terminology as it applies to the process industry.

4698 **IGT research experience in industrial and utility energy systems analyses.** Chicago, IL; Institute of Gas Technology (1979). 19p. (NP—24021).

Many energy system assessments have been made in which a number of subsystems have been synthesized into a conceptual energy delivery model and analyzed as whole. Areas covered under industrial energy systems analysis are: improved utilization efficiencies - technology implementation; hydrogen railroad system concept economic assessment; solar energy chemical processing applications; automotive transportation alternative fuels; LNG as fuel for subsonic aircraft transportation systems; LNG aircraft fuel utilization; coal conversion to hydrogen, methanol, and liquid fuels for aircraft. Areas covered under utility systems analysis are: coal gasification/fuel cell systems evaluation; projection for coal conversion facilities in Missouri River and Yellowstone River Basins; electrolytic hydrogen production utilizing off-peak power; advanced nuclear-electrolytic hydrogen-production facility preliminary systems-engineering study; low-head dam sites hydrogen production; LNG national export program initiation technical assessment; methane production using offshore wind energy; assessment of hydrogen energy production and delivery system for offshore wind energy conversion system; offshore wind power utilization; alternative energy transmission systems from ocean thermal energy conversion plants; transmission: the key to using ocean thermal energy; and OTEC delivery systems based on chemical-energy carriers optimization study.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 4590

4699 (TID—28706) **Coating industry: energy savings with volatile organic compound emission control.** (Centec Consultants, Inc., Fort Lauderdale, FL (USA)). 1979. Contract W-31-109-ENG-38. 113p. Dep. NTIS, PC A06/MF A01.

This Technology Applications Manual presents technical and economic data to enable engineers and managers in the coating industry to evaluate the energy-conservation opportunities for installation of solvent emission-control systems. Although the properties of the solvents vary considerably, the information contained in the report serves to improve the ability of the engineer to make quick estimations of energy savings, energy rates, economics, and performance of control systems and heat-recovery options. The emphasis is directed to a discussion of add-on devices, such as thermal and catalytic incineration. New technologies, such as the one recently demonstrated by the Department of Energy in cooperation with industry and the National Coil Coaters Association, are highlighted. Extensive graphics and illustrations show energy use, savings, and economics; these are supplemented by calculations to be used by each plant to determine site-specific data.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 4568, 4570, 4584, 4585, 4586, 4693

4700 (AD-A—064108) **Recovery of waste heat from propellant forced-air dry house. Final report, November 1976-April 1978.** Alario, J.; Bozza, E.F.; Mullaney, P. (Grumman Aerospace Corp., Bethpage, NY (USA)). Dec 1978. Contract DAAA21-77-C-0021. 103p. NTIS PC A06/MF A01.

This report describes the design, installation, and test evaluation of a heat pipe heat exchanger for a multi-base propellant forced-air dry house for the purpose of recovering heat from the hot air exhausted to the atmosphere during a typical drying operation. Detailed descriptions of the special safety and operating features of the recovery unit are also presented. Evaluation of the unit showed that approximately 62% of the energy used to dry multi-base propellants can be saved by the heat recovery technique employed. Energy/cost saving projections are based upon the installation of similar recovery units at a major Army propellant manufacturing facility such Radford Army Ammunition Plant.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 4481

4701 (BM-RI—8366) **Recovering byproduct heavy minerals from sand and gravel, placer gold, and industrial mineral operations.** Gomes, J.M.; Martinez, G.M.; Wong, M.M. (Bureau of Mines, Washington, DC (USA)). 1979. 15p. US Department of the Interior, Bureau of Mines, Washington, DC.

The Bureau of Mines, as part of an effort to maximize minerals and metals recovery from domestic resources, has investigated the feasibility of recovering heavy minerals as byproducts from sand and gravel, placer gold, and industrial mineral operations in northern California. Sand samples from about 50 locations were treated by gravity separation to yield heavy-mineral cocentrates (black sands). Mineral compositions of the concentrates were determined by chemical analysis and mineralogical examination. Individual zircon, ilmenite, magnetite, platinum-group metals, thoria, and silica products were prepared from heavy-mineral concentrates by selective separation using low- and high-intensity magnetic, high-tension, and flotation equipment.

4702 **Paper mill effluent gets fine treatment.** *Processing:* **25**: No. 1, 21(Jan 1979).

The use of waste paper in a Cumbrian mill, although helping to save on raw material costs, brought with it problems of effluent treatment because of the extra amount of fines which were produced in the process. The problems were solved with the installation of an undercover plant using a vertical settling tank which gave further advantages in easing solids disposal.

MUNICIPALITIES AND COMMUNITY SYSTEMS

4703 (COO—4488-2) **Georgetown University generic integrated community energy system GU-ICES demonstration project. Modified work management plan. Final report.** (Georgetown Univ., Washington, DC (USA)). Apr 1979. Contract EC-77-C-02-4488. 330p. Dep. NTIS, PC A15/MF A01.

This Phase II Modified Work Management Plan reflects the change from a Coal Using ICES to a Generic ICES Program. As such, it retains the essential elements relating to coal while broadening the number and types of alternative energy subsystems to be evaluated for eventual implementation on the Georgetown University Campus. In addition to the plan in Book I, Book II deals with an energy audit conducted at the campus in the fall of 1978 to establish a gross baseline from which to measure and evaluate the contributions of selected alternative energy subsystems both from an energy and cost standpoint. Book I proceeds from a discussion of an ICES through an explanation of the scope of effort in each phase expanded into detailed task descriptions by phase together with schedules, PERT and GANTT charts, milestones and levels of effort by task for the Feasibility Analysis, and schedules for the overall program. A description of examples of alternative subsystems to be considered is also included. A detailed Management Plan for the conduct of the effort by General Electric completes the plan. Appendices related to cogeneration, life-cycle costing, GE energy subsystems, the GU Master Energy Plan, and typical regulatory processes to be encountered are included. Book II treats the Energy Audit under the three committed task areas of System Description, Analysis and Survey, and Criteria for Energy Usage. The five major energy systems utilized at Georgetown are considered: electrical, chilled water, steam, gas and fuel oil, and city water. A top level analysis yields significant results and recommendations for further action with respect to a detailed measurements program, particularly of steam and electric power usage, over a one year period.

4704 (RLO—2332-3) **Development of procedures for application during the public facilities procurement process. Final report, Phase II extension. Minimizing consumption of exhaustible energy resources through community planning and design.** (Alaska State Div. of Energy and Power Development, Anchorage (USA)). Feb 1979. Contract EY-76-C-06-2332. 163p. Dep. NTIS, PC A08/MF A01.

Under a project funded by the US DOE, the State of Alaska's Division of Energy and Power Development has conducted a study of energy conservation measures that can be incorporated in public facilities and a new community such as that proposed for the State capital, should it be relocated. As a part of this study, the process by which such facilities are procured was revised to incorporate analysis of energy conservation measures and the control of their incorpo-

ration. Supporting procedures were also developed and are included in this report.

4705 (STUDSVIK/E1—79/76) **Heat pipes placed at the surface.** Spaangberg, K.G. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Apr 1979. 10p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

The aim of this project is to test and to demonstrate a movable pipe placed at the ground surface used in a district heating heat distribution system. The price for such a pipe is estimated to be one-half of the price for a conventional district heating pipe. Furthermore, such a pipe will be reusable. These two facts make it economically profitable to utilize sources of waste heat with shorter estimated lifetimes and which are placed at longer distances. The pipes are made of plastic and are insulated with polyurethane or mineral wool. Furthermore, an embankment is placed above the pipes to protect the pipe from damage.

4706 (WAOENG—79-7) **Energy impact review procedure: city of Bellevue.** (Weinstein (Michael N.) and Associates, Bellevue, WA (USA)). May 1979. 136p. Dep. NTIS, PC A07/MF A01.

An energy impact review process increases the opportunities available to building occupants to improve the stability of their activities, in light of energy price escalations and potential shortages of supply. This document has been organized within five sections. The first, Context for Energy Impact Review, describes: (1) the Federal and state context for considering an Energy Impact Review process; (2) precedents for Energy Impact Review in other states and local areas; (3) the function of Energy Impact Review; (4) the legal issues related to an Energy Impact Review process; and (5) estimated future energy price and supply conditions and their relevance to the need for a local Energy Impact Review process. The second, Submission Requirements, presents: (1) the content and form of information suggested for submission by a developer and his designer for purposes of Energy Impact Review; and (2) the relationship of this information to both the threshold determination and draft environmental impact statement process. The third, Question Sequences and Guidelines, contains: (1) sequences of questions that can be asked by project reviewers in order to clarify their understanding of energy related characteristics of proposed developments; and (2) energy and material conservation guidelines related to the question sequences. The fourth, Checklists, describes: (1) energy related checklists to be used in conjunction with the Submission Requirements and Question Sequences; and (2) initial valuing of attributes within the checklists for the City of Bellevue. The fifth, Areas of Emphasis, contains formats for assigning priorities to various energy related objectives.

4707 IGT research experience in community and building energy systems analyses. Chicago, IL; Institute of Gas Technology (1979). 13p. (NP—24027).

IGT has been involved in many community energy systems studies, including work on: advanced coal-using community systems; coal-based technologies evaluation for ICES; and solar total energy systems. In building energy systems, IGT's research work ranges from highly-detailed residential load analysis to the development of new appliance and environmental systems. Discussed are: wind-powered hydrogen-electric systems for farm and rural use; seasonal furnace efficiency improvement; adsorption (single-package heating and cooling); residential energy load analysis; heat pump systems performance; high-efficiency, gas-fired water heater; and solar energy applications.

4708 DESA programmer's manual: District Energy System Analysis. Verma, V. Ottawa, Ontario; Public Works Canada (1979). 226p. (NP—24177). Canadian Government Publishing Centre, Supply and Services Canada, Hull, Quebec, Canada K1A 0S9.

This manual is one of a series of three documents describing the District Energy System Analysis (DESA) computer programme developed at Public Works Canada. The other manuals are the Analytical Manual and the User's Manual. DESA is intended to provide, at the feasibility stage, some preliminary engineering design and a financial/energy life-cycle costing of specified district energy systems. DESA enables the user to define the loads and their configuration, and the location and type of central plant, and to obtain the dollar and energy costs of the system. By varying the input parameters, the user of DESA can obtain comparative values for various alternative systems. The manual contains the source listings of all DESA modules, definitions of variable names used in the programmes, and further information of use to those wishing to modify the DESA computer programme. DESA is programmed in SI units and has been designed to accept input data in SI and Imperial units. Output can be requested in either SI or Imperial units.

4709 Technical and economic bases of district heating development. Khrilev, L.S. (Siberian Power Inst., Irkutsk, USSR). pp 541-557 of Energy conservation in heating, cooling, and ventilating buildings: heat and mass transfer techniques and alternatives. Hoogendoorn, C.J.; Afgan, N.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Conference on heat and mass transfer in buildings; Dubrovnik, Yugoslavia (29 Aug 1977).

District heating in the USSR is treated as one of the most important parts of the energy economy, a source of large fuel economy and high-quality heat supply of towns, a powerful means for the normalization of the air basin, and a method of improving the reliability of energy supply. One of the main directions of the further development of district heating is the transition from conventional to nuclear heating and power plants. The economics of the district heating development on organic and nuclear fuel are different. It is determined by low fuel component of electric energy and heat at the nuclear electric stations, and, by the dependence of the nuclear electric station cost on the unit capacity of the reactor. At the NHPP, it is expedient to install large nuclear reactors and district heating turbines with a large condensating capacity. There may be cases, when the unit electric capacity of a nuclear electric station is limited, that require the building of a comparatively less economical specialized NHPP. For the long-term future it seems expedient to develop a special reactor for district heating, generating steam of high parameters and a reactor which will be able to supply high temperature process heat for industry. The complexity of development and operating conditions of modern district heating systems require the creation and use of complex methods for their optimization, based on the use of mathematical modelling and modern electronic computers in the design practice. The experience in developing and using these methods in the USSR shows their efficiency and the expediency of their wide application in the practice of designing.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 4530, 4568, 4570, 4576, 4578, 4579, 4581, 4585

4710 (ANL/CNSV-TM—7) **Heat-pump-centered integrated community energy systems. System development, Consolidated Natural Gas Service Company, interim report.** Tison, R.R.; Baker, N.R.; Yudow, B.D.; Sala, D.L.; Donakowski, T.D.; Swenson, P.F. (Institute of Gas Technology, Chicago, IL (USA); Consolidated Natural Gas Service Co., Inc., Cleveland, OH (USA)). Aug 1979. Contract W-31-109-ENG-38. 212p. Dep. NTIS, PC A10/MF A01.

Heat-pump-centered integrated community energy systems are energy systems for communities that provide heating, cooling, and/or other thermal energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources, rather than convert it from electrical or chemical to thermal form, HP-ICES offer a significant potential for energy savings. Results of the System Development Phase of the HP-ICES Project are given. The heat-actuated (gas) heat-pump incorporated into this HP-ICES concept is under current development and demonstration. The concurrent program was redirected in September 1977 toward large-tonnage applications; it is currently focusing on 60- to 400-ton built-up systems for multi-zone applications. This study evaluates the performance of a HAHP-ICES as applied to a community of residential and commercial buildings. To permit a general assessment of the concept in non-site-specific terms, the sensitivity of the system's performance and economics to climate, community size, utility rate structures, and economic assumptions is explored. (MCW)

4711 (PB—292770) **A real-time case history of ETIP Project 67 - integrated utility system application. Final report.** Taylor, J.G.; Lamar III, L.Q.C. (System Planning Corp., Arlington, VA (USA)). Mar 1978. Contract NBS-4-416151. 151p. NTIS PC A08/MF A01.

The major purpose of this report is to provide the real-time case history of ETIP Project 67--Integrated Utility System (IUS) and to provide the information that would permit lessons learned to be derived that, in turn, would be applicable to other ETIP projects. The Office of Facilities Engineering and Property Management (OFEPM) of the Department of Health, Education and Welfare initiated discussions with ETIP in 1973 to undertake a feasibility study and conceptual design of the Modular Integrated Utilities System (MIUS) for university/medical complexes. These discussions resulted in OFEPM submitting a proposal to ETIP in March 1974 requesting funds for the MIUS Application Project and the transfer of $220,000 by ETIP to OFEPM in June 1974. The IUS concept is on-site integration of five basic utility subsystems that serve building complexes: electrical power generation; heating and cooling; water supply; sewage treatment; and solid waste disposal.

4712 Feasibility of a heat-actuated heat-pump-centered integrated community energy system. Yudow, B.D.; Baker, N.R.; Tison, R.R.; Swenson, P.F. Chicago, IL; Institute of Gas Technology (1979). 6p. (CONF-790803—38). Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Integrated Community Energy Systems - be they district heating, district heating and cooling, or total energy systems - are receiving renewed interest in the US as promising approaches for providing the energy needs of a community and reducing total source energy consumption. These systems are not just revisions of proven technologies but are the fusion of new technology with proven technology, resulting in systems which are more energy efficient with lower life-cycle costs. The Heat-Actuated Heat-Pump-Centered - Integrated Community Energy System discussed is one such system. In this system, a small, high-efficiency steam turbine is combined with heat pump and thermal distribution technologies to meet the space conditioning needs of an office and residential community with over 30% less energy consumption when compared with conventional space-conditioning systems.

4713 (LIB-tr—4413) **Natural gas consumption peak-shaving by the production of butane-air mixtures. The Framatome Plant at Chalon-sur-Saone.** Barbier, M.G. (Association Technique de l'Industrie du Gaz de France, 75 - Paris). 1977. Translation of LRS—417. 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The existance of discontinuance or interruptibility of supply clauses and tariff penalty clauses in certain natural gas supply contracts may oblige manufacturers to look for a complementary source of energy. This paper proposes to explain how a problem of this kind has been solved so as to ensure a supply of gas under optimum flexibility and dependability conditions for the new Framatome plant at Chalon-sur-Saone. After refiewing certain underlying principles, the author devotes part of his paper to the interchangeability of gases. The subjects discussed include the conditions under which the fundamental aspects studied by Gaz de France in connection with interchangeability on the domestic market could be applied to industrial interchangeability. The matters considered in this connection are, basically, two Webbe numbers (an upper one and a lower one), an interchangeability index to ensure conservation of combustion atmospheres, and matters of pressure loss. The second part of the paper describes the essential elements of the butane air mixtures production installation at Framatone and stresses the reliability and automatic operation requirements which affected the construction of the plant. The last part of his paper outlines how an automation system implemented under different conditions could ensure improved management of a natural gas supply contract containing more complex clauses.

MUNICIPAL WASTE MANAGEMENT

4714 (NMEI—39) **Waste heat and waste products recovery potential for New Mexico. Final report, 1 September 1976-15 May 1977.** Hull, W.C.; Zallen, D.M.; Groth, E. Jr. (New Mexico State Univ., Las Cruces (USA). Dept. of Mechanical Engineering; New Mexico State Univ., Las Cruces (USA). Dept. of Chemical Engineering). Jun 1979. 66p. New Mexico Energy Inst., New Mexico State University, Las Cruces, NM 88003.

A survey of sources of waste energy in New Mexico was conducted, and results indicate agricultural and municipal wastes offer the greatest potentials for energy recovery or conversion. It is estimated that agricultural wastes offer a potential of 25 x 10^{12} Btu per year, while the municipal wastes from the state's nine largest cities offer a potential of 4.3 x 10^{12} Btu per year. Feasibile processes for recovering energy from these wastes include hydrogasification, pyrolysis and bioconversion; and, in the treatment of municipal refuse, simple incineration to recover energy preceded by recovery of valuable elements for recycling. Project efforts included computer searches of national agency data banks for reference to waste energy, mailing of questionnaires to selected industries and institutions in the state, collection of data from state agency statistical records, and the use of state and national reports on waste energy and its recovery. The goals and programs for any future similar studies in this field should concentrate on narrower targets and probe more deeply into the technology for energy recovery from a specific waste. Geographic distances within the state, the widespread origins of the various wastes identified and the unusual features of the processes available for recovery require that a specific proposal respond to a specific set of circumstances if an economically attractive recovery system is to be developed.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 4669, 4670

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 4906

SPARK-IGNITION

4715 (SAND—79-8715) **Comparison of ignition locations in a high swirl engine.** Smith, J.R. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 32p. (CONF-791048—4). Dep. NTIS, PC A03/MF A01.

From The Combustion Institute Western States Section meeting; Berkeley, CA, USA (15 Oct 1979).

A comparison of the effect of different ignition locations on engine performance in a high swirl, homogeneous charge, spark ignition engine has been made using a focused laser as the ignition source. Using the indicated mean effective pressure (IMEP) as the performance indicater, the ignition location was varied from the center of the cylinder to the cylinder wall by moving the laser focusing lens. Fifty to one-hundred millijoules of laser energy at 0.53 micron wavelength was required to give reliable ignition. The fuel was propane at an equivalence ratio of 0.8 at an engine speed of 1200 rpm. Whereas the spark location for optimum IMEP in a non-swirl engine is typically the center, it was found that IMEP did not vary significantly with ignition location in the high swirl engine. This unexpected result was apparently due to the short burn durations achieved with a very high swirl at time of ignition. Although there appeared to be a slight decrease in induction time using a laser instead of spark plug, no significant difference in the rates of pressure rise were observed when the laser deposition energy was comparable to that of the spark plug.

DIESEL

4716 (AD-A—062387) **Direct utilization of crude oil as fuel in US army four-cycle diesel engine, model LDT-465-1C. Interim report April 1977-August 1978.** Moffitt, J.V.; Frame, E.A. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Aug 1978. Contracts DAAG53-76-C-0003;DAAK70-78-C-0001. 34p. NTIS PC A03/MF A01.

Performance curves for the U.S. Army LDT-465-1C engine were obtained using DF-2 and crude oils of varying properties. A cyclic endurance test was run using crude oil as the fuel. The results of the crude oil fueled test were compared to test where DF-2 fuel was used. The crude oil resulted in significantly more engine wear and deposition than the DF-2. With crude oil fuel, the lubricant was severely degraded at end of test.

4717 (PB—295524) **Diesel bus performance simulation program. Final report mar 77-Apr 79.** Larson, G.; Zuckerberg, H. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Apr 1979. 204p. NTIS PC A10/MF A01.

A diesel bus performance computer simulation program was developed. This program provides information on acceleration, velocity, horsepower, distance traveled, and fuel consumption as a function of time from the originating station. The program was written for diesel engine operation although heat engines other than diesel may be substituted. Fuel economy calculations, using the program, agree well with available measurements on urban buses and may be considered as representative of a baseline urban bus. Component submodels and vehicle coefficients used in the program have been carefully structured to represent current urban buses. This report includes a general description of the simulation program and the type of input data it required along with the results obtained by simulating a typical transit bus.

TURBINE

REFER ALSO TO CITATION(S) 4729

4718 (COO—4867-05) **Gas turbine engines and transmissions for bus demonstration programs. Technical status report, 31 July 1979—31 October 1979.** Nigro, D.N. (General Motors Corp., Indianapolis, IN (USA). Detroit Diesel Allison Div.). Nov 1979. Contract EM-78-C-02-4867. 6p. Dep. NTIS, PC A02/MF A01.

The report summarizes the DDA activities for the effort performed on the procurement and delivery of eleven Allison GT 404-4 gas turbine engines and five HT740CT and six V730CT Allison automatic transmissions and the required associated software. The contract requires the delivery of the engines and transmissions for the Greyhound and Transit Coaches, respectively. In addition, software items such as cost reports, technical reports, installation drawings, acceptance test data and parts lists are re-

quired. A recent decision by the DOE will modify the build configuration for the last four (4) Transit Coach engines. It was decided by the DOE at a meeting in Washington, DC on March 28, 1979 with representatives from DDA, NASA/LeRC, JPL and Booz-Allen and Hamilton that these engines are to be built with ceramic regenerators. (TFD)

4719 (DOE/NASA/0037—79/1) **Conceptual design study of improved automotive gas turbine powertrain. Final report.** (Ford Motor Co., Dearborn, MI (USA); Garrett Corp., Phoenix, AZ (USA). Airesearch Mfg. Div.). May 1979. Contract EC-77-A-31-1040. 226p. (NASA-CR—159580). Dep. NTIS, PC A11/MF A01.

The report presents the results of an in-depth study for identifying an improved gas turbine for automotive applications. The study was performed by the Ford Motor Company and AiResearch Division of the Garrett Corporation under contract to DOE/NASA. The principal specified objectives of this contract were: (1) fuel economy a minimum of 20% better than 8.3 km/l (19.6 mpg) for a 1542 kg (3400 lbs.) test weight baseline vehicle, when tested over the Combined Federal Driving Cycle at emissions objectives of .41 gm/mi HC, 3.4 gm/mi CO, and .4 gm/mi NO/sub x/; (2) acceleration capability of 15 sec from 0 to 96.5 km/hr. (0 to 60 mph); and (3) a design capable of reaching a level of development in 5 yrs (by the year 1983) such that a decision to start a production program could be considered; additionally, Ford requirements for the engine were a fuel economy objective of 30 to 50% better than the baseline vehicle, and a 4 sec vehicle start-up distance of 19.5 m (64 ft.). Investigations for an improved gas turbine system identified twenty-two candidate engine concepts. These were examined judgementally, based on the previous experience of both contracting companies, and were ranked for fuel economy, cost packageability, risk of a long development program, and driveability feel. Double weight was assigned to the cost and fuel economy.

ELECTRIC-POWERED SYSTEMS

4720 (DOE/CS—0102/1) **Advanced subsystems for practical electric vehicles. Electric and Hybrid Vehicle Subsystems Technology Development Program.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Sep 1979. 25p. Dep. NTIS, PC A02/MF A01.

The Electric and Hybrid Vehicle (EHV) Subsystem Technology Program of the US Department of Energy (DOE) is charged with developing the advanced technology base, other than energy storage, necessary for practical electric and hybrid vehicles. The success of this endeavor requires close liaison and continued communication between the government, industry, and the consumer market. This brochure is intended to enhance this process. In addition to identifying current technology problem areas and outlining the potential solutions being pursued, it communicates to the EHV industry expected component and subsystem performance achivements to assist them in their product planning and future developmental activities. The document is also intended to serve as an avenue for obtaining additional information, as well as to describe the procedures for participating in the subsystem technology development program. For these latter purposes, appropriate contact points are identified.

4721 (DOE/TIC—10231) **State-of-the-art assessment of in-use electric and hybrid vehicles, FY 1978.** Harrow, B.R.; Howe, J.W.; Humphreys, D.W. (Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1979. Contract EC-77-A-31-1044. 622p. Dep. NTIS, PC A99/MF A01.

The document is a report of the second-year effort to assess the state-of-the-art of in-use electric and hybrid vehicles in support of Public Law 94-413, The Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976. The report is very comprehensive and is world-wide in scope. (TFD)

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 4720, 4721

VEHICLE DESIGN FACTORS

4722 (NTIS/PS—79/0273) **Tracked air cushion vehicle and magnetic levitation (citations from the NTIS data base). Report for 1964-February 1979.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 143p. NTIS PC N01/MF N01.

The feasibility, design, and track dynamics of tracked air cushioned and magnetically levitated vehicles are investigated in these Government-sponsored research reports. (This updated bibliography contains 135 abstracts, 8 of which are new entries to the previous edition.)

4723 (NTIS/PS—79/0274) **Tracked air cushion vehicles and magnetic levitation. Volume 1. 1970-1975 (citations from the Engineering Index data base). Report for 1970-75.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 220p. NTIS PC N01/MF N01.

The feasibility, design, and track dynamics of tracked air cushioned and magnetically levitated vehicles are investigated in these abstracts of reports gathered in a worldwide literature survey. (This updated bibliography contains 212 abstracts, none of which are new entries to the previous edition.)

4724 (NTIS/PS—79/0275) **Tracked air cushion vehicles and magnetic levitation. Volume 2. 1976-February, 1979 (citations from the Engineering Index data base). Report for 1976-February 1979.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 87p. NTIS PC N01/MF N01.

The feasibility, design, and track dynamics of tracked air cushioned and magnetically levitated vehicles are investigated in these abstracts of reports gathered in a worldwide literature survey. (This updated bibliography contains 81 abstracts, 17 of which are new entries to the previous edition.)

4725 **Ingredients of fuel economy.** Bechtold, R.L. Warrendale, PA; Society of Automotive Engineers, Inc. (1979). 18p. (CONF-791091—1).

From Fuels and lubricants conference; Houston, TX, USA (1 Oct 1979).

A broad overview of passenger car fuel economy is presented. The main components of vehicle power requirement (aerodynamics, rolling resistance, and inertia) are discussed for steady-state and driving cycle conditions. The effects of driveline losses and parasitic losses are mentioned. Fuel effects (alcohols vs hydrocarbons) are discussed along with engine types and differences due to combustion systems. The total energy required to propel a vehicle is calculated over the Environmental Protection Agency urban/highway driving cycles. The effects of vehicle weight, size, shape, and tire type on vehicle power requirement are presented, and fuel economy trends are predicted. Estimates of the fuel economy of a vehicle with regenerative braking are made.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 4906, 4907

4726 (NTIS/PS—79/0085) **Automobile air pollution: control equipment--catalytic converters. Volume 1. 1970-1976 (citations from the Engineering Index Data base). Report for 1970-76.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 205p. NTIS PC N01/MF N01.

This bibliography contains worldwide citations on automotive catalytic converters. They cover topics such as converter design and materials, performance tests, effectiveness in pollutant reduction, catalyst poisoning, catalyst selection, chemistry involved in the emission control, and the overall feasibility of using these converters under normal driving conditions. Also included are the problem and control of sulfuric acid and sulfate emissions. (This updated bibliography contains 201 abstracts, none of which are new entries to the previous edition.)

4727 (NTIS/PS—79/0086) **Automobile air pollution: control equipment--catalytic converters. Volume 2. 1977-February, 1979 (citations from the Engineering Index Data base). Report for 1977-February 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 112p. NTIS PC N01/MF N01.

The citations of worldwide engineering literature cover automotive catalytic converters. Included are such topics as converter design and materials, performance tests, effectiveness in pollutant reduction, catalyst poisoning, catalyst selection, chemistry involved in the emission control, and the overall feasibility of using these converters under normal driving conditions. The problems and control of sulfuric acid and sulfate emissions are discussed. (This updated bibliography contains 105 abstracts, 35 of which are new entries to the previous edition.)

4728 (PB—290953) **An assessment of the potential impact of combustion research on internal combustion engine emissions and fuel consumption. Final report, Dec 77-Apr 78.** Kerrebrock, J.L.; Kolb, C.E. (Aerodyne Research, Inc., Bedford, MA (USA)). Jan 1979. Contract DOT-TSC-1487. 92p. NTIS PC A05/MF A01.

A review of the present level of understanding of the basic thermodynamic, fluid dynamic, and chemical kinetic processes which affect the fuel economy and levels of pollutant exhaust products of diesel, stratified charge, and spark ignition engines is

presented. Key areas are identified where insufficient understanding currently prevents the rational development of internal combustion engines with improved performance. A research plan designed to gather the needed data is presented.

NITROGEN OXIDES

4729 (AD-A—067329) **Optical in situ versus probe measurements of nitric oxide concentration as a function of axial position in a combustor exhaust. Final report 21 Jul-27 Aug 77.** Few, J.D.; Bryson, R.J.; Lowry, H.S. III. (Arnold Engineering Development Center, Arnold Air Force Station, TN (USA)). Mar 1979. 37p. NTIS PC A03/MF A01.

Nitric oxide (N0) concentration was measured at three axial stations (6.5, 12, and 25 nozzle diameters downstream of a combustor nozzle exit) in a jet engine combustor exhaust by a gas-sampling probe in conjunction with conventional gas analyzers and an optical resonance absorption technique. The gas analyzer system permitted measurements of NO, NO sub x, CO, CO sub 2, and C sub x, H sub y (total hydrocarbons) whereas the optical absorption technique permitted measurement of NO only. The combustor was exhausted into a test cell of slightly less than atmospheric pressure and was operated at an inlet air temperature of 589 K, a total pressure of 344.3 kPa, and a fuel-to-air ratio (f/a) of 0.02. A multiprobe rake was used to acquire emissions, total pressure and temperature, and static pressure data at the measurement stations. The measurements of total pressure, total temperature, and measured static pressure were used to determine static temperature and pressure profiles at each measurement station, which are required for determining NO concentration by the optical absorption technique.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 4895

HYDROCARBONS

REFER ALSO TO CITATION(S) 4895

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 4716

4730 (LA-UR—79-2883) **Liquid hydrogen-fueled vehicle project.** Stewart, W.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-791082—1). Dep. NTIS, PC A02/MF A01.

From DOE automotive technology development contractors coordination meeting; Dearborn, MI, USA (23 Oct 1979).

The US Department of Energy, Department of Transportation Energy Conservation, the Los Alamos Scientific Laboratory, the New Mexico Energy Institute, and the Deutsche Forschungs-und Versuchsanstalt fur Luft-und Raumfahrt are participating in a cooperative evaluation and state-of-the-art demonstration project for liquid hydrogen vehicle onboard storage and refueling techniques. The evaluation will also include safety, economic, and energy assessments for liquid hydrogen as a fuel. The project will provide a baseline system representing present capabilities in engine conversion, liquid hydrogen storage, and liquid hydrogen refueling.

MATERIALS

REFER ALSO TO CITATION(S) 5074, 5127

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 4740, 4743, 4744, 4745, 4746

4731 (ANL/OEPM—78-5) **Preliminary thermodynamic assessment of processes to produce aluminum using aluminum sulfide as an intermediate product.** Loutfy, R.O.; Keller, R.; Cook, G.M. (Argonne National Lab., IL (USA)). Sep 1979. Contract W-31-109-ENG-38. 66p. Dep. NTIS, PC A04/MF A01.

New processes for the production of aluminum, which use aluminum sulfide as an intermediate product, are described. According to thermodynamic data and equilibrium compositions calculated from a NASA-Lewis code, the energy required for the production of aluminum by such a process is much lower than that of the present Hall-Heroult process or the new process under development at Alcoa ($AlCl_3$ electrolysis). Future studies are recommended on the technical feasibility and economics of aluminum sulfide processes for producing aluminum.

4732 (RFP—2897) **Forging evaluaion of 304L stainless steel.** Packard, C.L.; Edstrom, C.M. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 29 Oct 1979. Contract EY-76-C-04-3533. 64p. Dep. NTIS, PC A04/MF A01.

The objective of this project was to evaluate and characterize the effects of various forging parameters on the metallographic structure and mechanical properties of 304L stainless steel forgings. Upset and die forgings were produced by hammer and Dynapak forging with forging temperatures ranging from 760 to 1145°C, upset reductions ranging from 20 to 60%, and annealing times ranging from 0 to 25 minutes at 843°C. The carbide precipitation behavior observed was found to be a function of forging temperature and annealing time. Higher forging temperatures were beneficial in avoiding continuous carbide precipitation and annealing at 843°C promoted increased carbide precipitation. The yield strength of the unannealed forgings decreased with increasing forging temperature and, with the exception of the 1145°C upset forgings, was significantly lowered by annealing.

4733 (WARD-HT—94000-3) **Creep rupture tests of type 304 stainless steel weldments with central transverse welds of type 308 stainless steel at 593°C.** Manjoine, M.J. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Sep 1979. Contract AM02-79CH94000. 75p. AT.

Results of creep rupture tests at 593°C of 304SS plates with transferse 308CRE welds at mid-length are presented. Cracks initiate at the heat affected zones at about mid-life when the local axial strain reaches a value of about 1.75%. A comparison of the ASME code design stresses indicates that these weldments yield higher design stresses than those for the basemetal.

4734 **Palladium sintering: shrinkage kinetics for a sponge powder.** German, R.M. (J.M. Ney Co., Bloomfield, CT); Ham, V. *Metall. Trans., A;* **10A**: No. 11, 1593-1596(Nov 1979).

Pellets pressed from sponge palladium powder were sintered both isothermally and with constant heating rates using a precision low force dilatometer. Computer analysis of the data is used to determine shrinkage and shrinkage rate behavior during the sintering operation. The data are used in conjuction with metallographic examination to correlate the shrinkage phenomena to the change in grain size and pore morphology. The results show a characteristic shrinkage rate behavior associated with grain growth during sintering which can effectively halt densification.

4735 **Determination of phosphorus in gold or silver brazing alloys.** Antepenko, R.J. (General Electric Co., St. Petersburg, FL). DE-AC04-76DP00656. *Metall. Trans., A;* **10A**: No. 11, 1777-1779(Nov 1979).

A spectrophotometric method was devised for measuring microgram levels of phosphorus in brazing alloys of gold or silver that contain high nickel concentrations. Phosphorus in such alloys is normally measured by solid mass spectrometry, but the high nickel concentration produces a double ionized nickel spectral interference. The described procedure is based upon the formation of molybdovanadophosphoric acid when a molybdate solution is added to an acidic solution containing orthophosphate and vanadate ions. The optimum acidity for forming the yellow colored product is 0.5 N hydrochloric acid. The working concentration range is from 0.1 to 1 ppM phosphorus using 100 mm cells and measuring the absorbance at 460 nm. The sample preparation procedure employs aqua regia to dissolve the alloy and oxidize the phosphorus to orthophosphate. Cation exchange chromatography is used to remove nickel ions and anion exchange chromatography to remove gold ions as the chloride complex. Excellent recoveries are obtained for standard phosphorus solutions run through the sample procedure. The procedure is applicable to a variety of gold or silver braze alloys requiring phosphorus analysis.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 4732, 4739

4736 **Dislocation transport and hydrogen embrittlement.** West, A.J. (Univ. of California, Livermore); Louthan, M.R. Jr. *Metall. Trans., A;* **10A**: No. 11, 1675-1682(Nov 1979).

Tensile tests of several austenitic stainless steels show that when smooth bar samples are exposed to very high pressure hydrogen significant degradation in mechanical properties is observed. This degradation is accompanied by fracture along interfaces such as grain and twin boundaries although microvoid coalescence remains a prominent fracture feature. The interface cracking and loss in ductility increases as the exposure pressure increases to 172.5 MPa and at the higher pressures the adverse effects of hydrogen are enhanced by warm working operations. Rationalization of these data show that

dislocation transport of hydrogen is not required in the embrittlement process; constraint, local lattice dilation, hydrogen content of interfaces are the dominant variables influencing the hydrogen affected fracture processes.

4737 Effect of heat treatment on microstructure and mechanical properties in 52100 steel. Kar, R.J. (Anamet Labs., Berkeley, CA); Horn, R.M.; Zackay, V.F. *Metall. Trans., A;* **10A**: No. 11, 1711-1717(Nov 1979).

An investigation was carried out to study the microstructure and mechanical properties of isothermally transformed AISI E 52100 steel. Heat treatments consisting of single and two cycle austenitization followed by isothermal holding resulted in duplex structures of martensite and bainite. In addition, high temperature austenitization led to large amounts of retained austenite at room temperature. Conventional oil quenching treatments were also performed for purposes of comparison. It was found that isothermal holding above M/sub S/ after single cycle austenitization resulted in a microstructure which had strength and toughness properties equivalent to quenched and tempered 52100. The two cycle austenitization treatment followed by isothermal holding led to a doubling of the fracture toughness at equivalent hardness and ultimate tensile strength levels relative to the properties of conventional quenched and tempered 52100 steel. The mechanical stability of retained austenite, present after two cycle austenitization, was examined. Although it was found that the presence of unstable retained austenite was associated with the best combination of strength and toughness, it cannot be unequivocally stated that the retained austenite influenced the mechanical properties.

4738 Growth of grain boundary cavities under applied stress and internal pressure . Mancuso, J.F. (Westinghouse Research Labs., Pittsburgh, PA); Li, C.Y. *Metall. Trans., A;* **10A**: No. 11, 1719-1722(Nov 1979).

Experiments were performed to investigate the growth of grain boundary cavities in nickel under internal pressure and applied stress. Under the experimental conditions the growth kinetics was found to be controlled by stress induced mass transfer. The growth rate was a nonlinear function of the applied stress and was found to depend on grain boundary orientation and grain boundary sliding.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 4732, 4733, 4736, 4737, 4756

4739 (DP-MS—79-22) **Notch and hydrogen effects on sensitized 21-6-9 stainless steel.** Caskey, C.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 18p. (CONF-790910—5). Dep. NTIS, PC A02/MF A01.

From Symposium on calculation of phase diagrams and thermochemistry; Milwaukee, WI, USA (17 Sep 1979).

Type 21-6-9 stainless steel alloy is slightly notch sensitive in the solution annealed condition, a behavior that is aggravated by sensitization anneal at 920°K. The lower toughness of the sensitized alloy is a measure of microstructural embrittlement associated with carbide precipitation in grain boundaries. The tendency toward grain boundary fracture in the sensitized alloy is accentuated by stress concentration at the notch. Also, there is an increase in notch sensitivity when the alloy is tested in a high pressure (69 MPa) hydrogen environment, due to susceptibility of the grain boundaries to hydrogen embrittlement.

4740 (RDT-M—7-6T(8-78)(Rev.)) **Precipitation-hardening stainless steel bars, shapes, and forgings (ASME SA-564 with additional requirements).** Fuller, R.M. (Oak Ridge National Lab., TN (USA)). 23 Nov 1979. Contract W-7405-ENG-26. 8p. RSO.

This standard covers precipitation-hardening stainless steel bars, shapes, and forgings for nuclear and associated applications. Material shall conform to the requirements of ASME SA-564; to requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

4741 Creep fracture maps for 316 stainless steel. Miller, D.A.; Langdon, T.G. (Univ. of Southern California, Los Angeles). Contract EY-76-S-03-0113 PA-26. *Metall. Trans., A;* **10A**: No. 11, 1635-1641(Nov 1979).

Creep fracture processes may be plotted in the form of a map by using the equations for the times to fracture for each process. A new and simplified form of creep fracture map is introduced in which the logarithmic normalized stress is plotted against the reciprocal of the homologous temperature. In this form, both the field boundaries between the different fracture processes and the contours of constant time to fracture appear as straight lines. Maps are presented for 316 stainless steel using four different creep processes: transgranular creep fracture, triple point cracking, and intergranular cavitation controlled by either diffusion growth or power-law growth. It is demonstrated that a map constructed for 316 stainless steel having a grain size of 40 μm is in good agreement with published experimental fracture data.

4742 Effect of substructure on the mechanical properties of Fe-Ni-Co-C alloys. Raghavan, M. (Exxon Research and Engineering Co., Linden, NJ); Thomas, G. *Metall. Trans., A;* **10A**: No. 11, 1665-1673(Nov 1979).

The effect of transformation substructure (lath or twinned plates) and its subsequent modification of carbide distribution during tempering on the mechanical properties was investigated in Fe-Ni-Co alloys with and without 0.1 pct carbon. The morphology and substructure of carbon free and 0.1 pct carbon Fe-Ni-Co martensites do not have a significant effect on fracture toughness. The transformation substructure by itself does not control the deformation mode of these martensites. Based on a previously suggested model on factors affecting the mode of deformation, the need for substructure control to maintain desirable mechanical properties of low alloy high strength steels is again emphasized.

4743 (RDT-M—3-33T(8-79)(Rev.)) **2-1/4%-chromium, 1%-molybdenum alloy steel seamless tubes (ASME SA-213 with additional requirements).** Fuller, R.M. (Oak Ridge National Lab., TN (USA)). 18 Oct 1979. Contract W-7405-ENG-26. 7p. RSO.

This standard covers 2-1/4%-chromium, 1%-molybdenum alloy steel seamless tubes for use in heat exchangers and steam generators for nuclear and associated applications. Material shall conform to the requirements of ASME SA-213, Grade T22; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

4744 (RDT-M—7-10T(8-79)(Rev.)) **Nickel-iron-chromium alloy rod and bar (ASME SB-408 with additional requirements).** Fuller, R.M. (Oak Ridge National Lab., TN (USA)). 18 Oct 1979. Contract W-7405-ENG-26. 4p. RSO.

This standard covers nickel-iron-chromium alloy rod and bar forgings for nuclear and associated applications. Material shall conform to the requirements of ASME SB-408; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

4745 (RDT-M—3-17T(8-79)(Rev.)) **Nickel-molybdenum-chromium alloy welded pipe (ASME SA-358 with additional requirements).** Fuller, R.M. (Oak Ridge National Lab., TN (USA)). 16 Oct 1979. Contract W-7405-ENG-26. 5p. RSO.

This standard covers large diameter nickel-molybdenum-chromium alloy welded pipe for nuclear and associated applications. Pipe shall conform to the requirements of Code Case 1345, the applicable requirements of ASME SA-358; to the applicable requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

4746 (RDT-M—1-4T(8-79)(Rev.)) **Low alloy steel covered welding electrodes (ASME SFA-5.5 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 10p. RSO.

This standard covers low alloy steel covered welding electrodes for nuclear and associated applications. Material shall conform to the requirements of ASME SFA-5.5; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 4731, 5034, 5130

4747 (AD-A—062382) **Re-entrant superconductivity in a magnetically ordered superconductor: La(1-x)Gd(x)Ru$_2$.** Jones, T.E.; Kwak, J.F.; Chock, E.P.; Chaikin, P.M. (California Univ., Los Angeles (USA). Dept. of Physics). 1978. 8p. NTIS PC A02/MF A01.

We have measured the critical temperature (Tc) and the upper critical magnetic field (Hc2) of La(1-x)Gd(x)Ru2. At low concentrations of the magnetic impurity (Gd), the suppression of Tc follows the expected Abrikosov-Gorkov (A-G) pair breaking curve. However, for larger concentrations, strong deviations below A-G are observed. Samples in this region (4. < or = x < or = 5. at. %) exhibit two Tc's. La(1-x)Gd(x)Ru2 is known to order magnetically, probably as a spin glass, and the magnetic ordering temperature (T sub M) has been measured in the normal state. This T sub M curve intersects the Tc curve in the concentration range where the Tc curve is re-entrant and we therefore attribute the re-entrant Tc behavior to the magnetic ordering of the Gd(3+) ions.

4748 (BNL—26264) **Coulometric titrations using CaF_2 and BaF_2 solid electrolytes to study alloy phases.** Delcet, J.; Delgado-Brune, A.; Egan, J.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 12p. (CONF-790910—2). Dep. NTIS, PC A02/MF A01.

From Symposium on calculation of phase diagrams and thermochemistry; Milwaukee, WI, USA (17 Sep 1979).

Several binary Ca and Ba alloy systems have been studied by emf measurements on cells. By applying different potentials across cell (I), the concentration of Ca was varied in the left-hand electrode. Results yield thermodynamic data and phase equilibria information. Results on single phase solids determine limits of stoichiometry and degree of disorder. Systems studied were Ca-Au(l), Ca-Pb(l), Ca-Sn(l), Ca-Bi(l or s), Ca-Sb(l or s) and Ca-Tl(l). Cells of type (I) were also operated with BaF_2 electrolytes and results presented for Ba-Pb(l), Ba-Sn(l), Ba-Sb(l or s) and Ba-Bi(l) alloys. Experimental details and limitations are discussed.

4749 (LBL—9471) **Chemisorption and reactivity studies of small molecules on rhodium surfaces.** Castner, D.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 211p. Dep. NTIS, PC A10/MF A01.

The chemisorption of H_2, O_2, CO, CO_2, NO, C_2H_2, C_2H_4, and C was studied on the clean Rh(111), (100), (755), and (331) surfaces. Low-energy electron diffraction (LEED), Auger electron spectroscopy (AES) and thermal desorption mass spectroscopy (TDS) were used to determine the size and orientation of the unit cells, desorption temperatures and decomposition characteristics for each adsorbate. All of the molecules studied readily chemisorbed on all surfaces and several ordered surface structures were observed. 190 references (JFP)

4750 **Four-wave sum mixing in beryllium around hydrogen Lyman-α.** Mahon, R.; McIlrath, T.J.; Tomkins, F.S.; Kelleher, D.E. (Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *Opt. Lett.;* **4**: No. 11, 360-362(Nov 1979).

Radiation was generated between 1210 and 1230 A by four-wave sum mixing in beryllium vapor where the $2s^2\ ^1S$—$2s3d\ ^1D$ transition was two-photon resonant. Result indicate that beryllium will be an efficient nonlinear medium in this spectral region with improvements to the stability of the furnace to allow phase matching and operation at higher pressures.

4751 **Atomic physics of channeled ions.** Crawford, O.H.; Ritchie, R.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **20**: No. 5, 1848-1858(Nov 1979).

Electronic states of swift channeled ions are studied in terms of a time-dependent effective-Hamiltonian theory. These states are shifted in energy by the electric potential of the perturbed crystal, and transitions among them are induced coherently by the oscillation of the potential. Calculated energies for low-lying states of hydrogenic ions channeled in Au are in reasonable agreement with experimental resonant coherent-excitation spectra.

4752 **Heats of formation of transition-metal alloys.** Watson, R.E.; Bennett, L.H. (Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev. Lett.;* **43**: No. 15, 1130-1134(8 Oct 1979).

This Letter proposes a scheme for obtaining the d-electron energy-band parameters to be used in a simple analytic model of the alloy heat of formation, ΔH. The scheme employs, as an intermediate step, the equalization of the local chemical potentials of the two sites. Calculations for 3d, 4d, and 5d metal alloys yield ΔH in accord with experimental trends, but, unlike earlier estimates, with d charge transfer in the direction indicated by experiment.

4753 **Dependence of flux-flow critical frequencies and generalized bundle sizes on distance of fluxoid traversal and fluxoid length in foil samples.** Thompson, J.D.; Joiner, W.C.H. (Physics Department, University of Cincinnati, Cincinnati, Ohio). *J. Low Temp. Phys.;* **37**: No. 1, 13-30(1 Oct 1979).

Flux-flow noise power spectra taken on $Pb_{80}In_{20}$ foils as a function of the orientation of the magnetic field with respect to the sample surfaces are used to study changes in frequencies and bundle sizes as distances of fluxoid traversal and fluxoid lengths change. The results obtained for the frequency dependence of the noise spectra are entirely consistent with our model for flux motion interrupted by pinning centers, provided one makes the reasonable assumption that the distance between pinning centers which a fluxoid may encounter scales inversely with the fluxoid length. The importance of pinning centers in determining the noise characteristics is also demonstrated by the way in which subpulse distributions and generalized bundle sizes are altered by changes in the metallurgical structure of the sample. In unannealed samples the dependence of bundle size on magnetic field orientation is controlled by a structural anisotropy, and we find a correlation between large bundle size and the absence of short subpulse times. Annealing removes this anisotropy, and we find a stronger angular variation of bundle size than would be expected using present simplified models.

CORROSION AND EROSION

4754 (AD-A—062571) **Mechanisms of hydrogen embrittlement - crack growth in a low-alloy ultra-high-strength steel under cyclic and sustained stresses in gaseous hydrogen. Materials report.** Lynch, S.P.; Ryan, N.E. (Aeronautical Research Labs., Melbourne (Australia)). May 1978. 23p. NTIS PC A02/MF A01.

Rates of crack growth in a low-alloy ultra-high-strength steel (D6aC) under cyclic and sustained stresses have been measured as functions of stress-intensity, for different cyclic wave-forms and frequencies, in low pressure (13.3 kPa) hydrogen, dry air, and vacuum (.001 Pa) environments; sustained-load cracking in liquid mercury was also studied. Frequency and wave-form had large effects on rates of fatigue-crack growth in hydrogen but little influence on fatigue in air and vacuum. For triangular wave-forms, rates of crack growth in hydrogen were determined mainly by the stress-intensity range and the load-rise time. For square-wave loading, rates of crack growth in hydrogen were proportional to the time at maximum load. Quantitative relationships between rates of cracking under sustained and cyclic loads were not found. Many similarities between hydrogen-embrittlement and liquid-metal embrittlement (e.g. surfaces of the intercrystalline fractures induced by hydrogen and mercury were sometimes indistinguishable) suggested that the mechanism of embrittlement is basically the same in both cases. It is considered that previous explanations for embrittlement are not consistent with the present fractographic observations (e.g. dimpled transcrystalline fractures were sometimes observed after crack growth in mercury and hydrogen). The present results suggest that the effects of hydrogen and liquid-metal environments on crack growth can generally be explained on the basis that chemisorption influences interatomic bonds/spacings at surfaces (crack tips) and thereby facilitates nucleation of dislocations at crack tips.

4755 (FE—3050-T2) **Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement.** Johnson, E.W.; Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 23 Aug 1979. Contract ET-78-C-01-3050. 17p. Dep. NTIS, PC A02/MF A01.

Hydrogen sulfide environmental tests on a 2-1/4 Cr-1 Mo sample are presented. The present emphasis is on modifying a testing technique for low yield strength steels (by ~ 100 ksi) in which (i) plane stress-plane strain and (ii) incubation time problems are severe. It is demonstrated that the plane stress zones pin the crack and that these zones can be eliminated by side grooving the specimen. The incubation time is reduced by pre-fatiguing in the environment. The reasons for using an arrest stress intensity value, from a simulated bolt load test (K/sub arr/), rather than a crack onset K, from a rising load test (K_o) for an assessment of hydrogen embrittlement susceptibility are given. It is shown in this sample that a smooth sided 3T specimen has a K_o ~ 150 ksi in /sup 1/2/ whereas a side grooved 2T specimen has a K/sub arr/ ~ 20 ksi in /sup 1/2/.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 5198

4756 (WAPD-TM—1425) **Evaluation of the mechanical properties of an irradiated Type 347 stainless steel in-pile tube with a peak fluence of 4 x 10^{22} n/cm^2 (>1 MeV).** Krupowicz, J.J. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Aug 1979. Contract EY-76-C-11-0014. 45p. Dep. NTIS, PC A03/MF A01.

Results of postirradiation mechanical testing of Type 347 stainless steel specimens machined from an Engineering Test Reactor in-pile pressure tube are presented. Tests included tensile and fracture toughness at room temperature, 600°F, 800°F, and 1000°F, room temperature fatigue, and delayed failure stress rupture with stresses approaching the yield stress. Immersion density measurements were also made. Specimen fluences varied up to 4 x 10^{22} n/cm^2 (>1 MeV). Although irradiation increased the strength, the material remained ductile and showed no evidence of notch or strain rate sensitivity, or embrittlement. Static and dynamic fracture toughness values were well above the minimum failure criterion requirements. At higher fluence all of the mechanical properties appear constant, indicating saturation of the irradiation damage. Extended in-pile service of such in-pile pressure tubes to 4 x 10^{22} n/cm^2 (>1 MeV) was justified.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 4472

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 4549

STRUCTURE AND PHASE STUDIES

4757 (ND-R—143(D)) **Accurate measurement of lattice parameters using a Bragg-Brentano x-ray diffractometer applied to neutron irradiated silicon carbide.** Berry, T. (UKAEA Dounreay Nuclear Power Development Establishment). Apr 1979. 21p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States--UKAEA Fast Reactor Exchange Program.

Silicon carbide fast reactor temperature monitors are evaluated at DNPDE from lattice parameter changes measured by X-ray diffraction. Neutron irradiation produces different degrees of diffraction line broadening and Bragg angles are defined by line peaks, centroids, or mid-chord peaks as the Kα lines become progressively broader. Due to the large numbers of lattice parameters to be measured the ultimate precision inherent in the techniques is not realized, but the coefficient of variation in the lattice parameter results for beta-silicon carbide has been improved from 0.02 to 0.05% to 0.003 to 0.009%.

4758 (UCRL—15098) **Mechanical and dielectric properties of optical films. Final report for Lawrence Livermore Laboratory.** Wenz, R.P.; Fontanella, J.F.; Shure, M.; Hoffman, R.W.; Schuele, D.E. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics). 1979. Contract W-7405-ENG-48. 61p. Dep. NTIS, PC A04/MF A01.

The intrinsic stress and microstructure of vacuum deposited TiO/sub x/ thin films were studied as a function of oxygen partial pressure and substrate temperature (T/sub s/). Auger electron spectroscopy (AES) combined with Rutherford backscattering spectroscopy (RBS) provided quantitative depth profiles of composition. Transmission electron microscopy and selected area diffraction allow structural characterization. Two temperature regions of differing stress and microstructural character are apparent. For T/sub s/ < 150°C the films are amorphous and the stress is independent of film thickness. In addition, stress changes occur upon exposure to room air resulting in a final stress of ~ 3 x 10^9 dynes/cm^2 independent of the oxygen partial pressure and substrate temperature. At T/sub s/ = 300°C the stress is again constant with film thickness having a value of ~ 6 x 10^9 dynes/cm^2 independent of the oxygen partial pressure. However, the stress is stable upon exposure to room air. At T/sub s/ = 300°C the films are polycrystalline with regions of TiO_2 (anatase). Compositional data showed large variations, possibly indicating a void structure with varying quantities of water vapor. Dielectric data were difficult to obtain owing to the large ionic conductivity present in the films.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 4549, 4758

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 4758

4759 (SAND—79-0549C) **Characterization of hydrogen species on metal-oxide surfaces by electron-stimulated desorption: TiO_2 and $SrTiO_3$*.** Knotek, M.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 15p. (CONF-790956—2). Dep. NTIS, PC A02/MF A01.

From Conference on non-traditional approaches to the study of the solid-electrolyte interface; Snowmass, CO, USA (23 Sep 1979).

The hydrogen species on TiO_2 and $SrTiO_3$ have been characterized using the site specificity of electron-excited Auger Stimulated Desorption (ASD). Hydrogen is found to be bonded to surface Ti's in hydride-type bonds, to subsurface or bridgebonded O's in a hydroxyl-like bond, or be part of a surface hydroxyl. On $SrTiO_3$ the Ti-H and surface OH species are also found plus a high density of Sr-H and very little Sr-OH bonding. The general features of ASD, both electron- and photon-excited, are discussed.

POLYMERS AND PLASTICS

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 4547

4760 **High pressure studies of poly (N-vinylcarbazole) eximer emission in polymer films.** Chryssomallis, G.; Drickamer, H.G. (School of Chemical Sciences and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). EY-76-C-02-1198. *J. Chem. Phys.;* **71**: No. 12, 4817-4823(15 Dec 1979).

The excimer fluorescence properties of poly (N-vinylcarbazole) (PVCA) dissolved in a variety of polymer films were investigated. The existence of two interchain excimers emitting from frozen preformed sites in the film was observed. Large hydrostatic pressures were used in order to change the local environment of the two sites. Changes with pressure of the ratio of respective intensities are interpreted according to a hopping singlet exciton diffusion model with the two sites acting as competing traps. There are two distinct mechanisms, one predominant at low and the other at high pressures. The assumption that a small rearrangement between the two excimers is possible at low pressures is valid since both glass transition temperatures and overall intensity changes support it. The change of volume in the transformation between the two excimers was calculated for the different films and is equal to or less than 3% of the monomer molar volume.

4761 **Phase fluorometry as a probe of diffusion-controlled molecular encounters in dense fluids.** Baird, J.K.; Arakawa, E.T.; Noid, D.W.; Petty, H.R. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **71**: No. 12, 5081-5089(15 Dec 1979).

The Wilemski—Fixman model for diffusion-controlled molecular encounters in dense fluids is included as one step in a mechanism governing fluorescence quenching. The mechanism is analyzed by mathematics appropriate to a phase fluorometry experiment. As customary, time varying parts of the excitation and fluorescence are found to differ from one another by an amplitude and a phase. Expressions for this amplitude and phase are given in terms of the frequency of modulation of the excitation, the lifetime of the excited state, the diffusion coefficients and radii of the fluorophore and quencher, respectively, and the specific rate of collisions between fluorophore and quencher. There is obtained as a by-product of this analysis an expression for the Stern—Volmer coefficient in terms of the same set of variables. We analyze in some detail a combination of Stern—Volmer and phase fluorometry experiments which can be used to test the Wilemski—Fixman model.

RADIATION EFFECTS

4762 (ORNL/TM—7077) **Radiation effects on organic insulators for superconducting magnets. Annual progress report for period ending September 30, 1979.** Coltman, R.R. Jr.; Klabunde, C.E.; Kernohan, R.H.; Long, C.J. (Oak Ridge National Lab., TN (USA)). Nov 1979. 56p. Dep. NTIS, PC A04/MF A01.

The most recent efforts in a program to study the effects of irradiation near 5 K on organic insulators for fusion reactors have extended the irradiation dose from 2 x 10^9 to 1 x 10^{10} rads and have studied additional effects due to fast neutrons. When added to a gamma-ray dose of 2.4 x 10^9 rads, a fast-neutron fluence of 2.4 x 10^{20} n/m^2 has little effect upon changes in electrical and mechanical properties. At this dose, present results are in agreement with previous results. At a dose of 1 x 10^{10} rads, particle-filled epoxies are at end of life in terms of mechanical strength, while fiberglass-cloth-filled epoxies retain sufficient strength for use. Electrical-resistivity and voltage-breakdown values were reduced in some materials but remained in a usable range. Two sheet-type materials showed excellent stability in their electrical properties. Dimensional stability was generally good, except for one epoxy which showed considerable swelling at the higher dose.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 4169, 4170, 4172, 4173, 4175, 4176, 4177, 4178, 4179, 4187

4763 (SAND—79-1709) **Semiconductor development laboratory computer control software.** Doyal, L.A. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 101p. Dep. NTIS, PC A06/MF A01.

A group of programs was written to control semiconductor processing in the lab and keep track of device histories during wafer fabrication. These programs are described in this report.

PROPERTIES

REFER ALSO TO CITATION(S) 4075

4764 (COO—1198-1281) **Phonon-dislocation interaction.** Anderson, A.C. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 8p. Dep. NTIS, PC A02/MF A01.

Thermal conductivity measurements on LiF crystals in the temperature range 0.04 to 30 K have demonstrated that, throughout

this range, thermal phonons interact with dislocations via a dynamic or resonant process which is highly frequency- and phonon-mode dependent. The results of earlier work are consistent with this interpretation.

4765 Photoluminescence from hydrogenated ion-implanted crystalline silicon. Pankove, J.I.; Wu, C.P. (RCA Laboratories, Princeton, New Jersey 08540). *Appl. Phys. Lett.;* **35**: No. 12, 937-939(15 Dec 1979).

Ion-implanted crystalline silicon annealed in atomic hydrogen photoluminesces at 0.99 +- 0.01 eV in a band having a spectral width of 0.1 eV FWHM. The emitted spectrum does not depend on the chemical nature of the implanted ion (Al, As, D, F, H, Ne, P, Si); however, when the surface is amorphized, a spectrum characteristic of hydrogenated amorphous Si is obtained.

4766 Picosecond infrared-continuum generation by three-photon parametric amplification in $LiNbO_3$. Campillo, A.J.; Hyer, R.C.; Shapiro, S.L. (Los Alamos Scientific Laboratory, University of California, P. O. Box 1663, Los Alamos, New Mexico 87545). *Opt. Lett.;* **4**: No. 11, 357-359(Nov 1979).

Picosecond infrared continua are produced by propagating an intense ultrashort 1.064-μm pulse through a $LiNbO_3$ crystal set near the degenerate point. Under our experimental conditions, gain broadening is identified as the principal mechanism leading to the superbroad spectral output.

4767 Neutron scattering study of the dynamics of (KCN)/sub 0.5/(KBr)/sub 0.5/. Rowe, J.M.; Rush, J.J.; Hinks, D.G.; Susman, S. (National Measurement Laboratory, National Bureau of Standards, Washington, D. C. 20234). *Phys. Rev. Lett.;* **43**: No. 16, 1158-1161(15 Oct 1979).

Our earlier measurements on pure KCN and (KCN)/sub 0.25/(KBr)/sub 0.75/ have been extended to mixed crystals of (KCN)/sub 0.5/(KBr)/sub 0.5/. From a comparison of the observed neutron scattering line shapes to those predicted by a simple extension of the theory used to describe pure KCN, it is concluded that this theory does not describe the mixed systems correctly. This Letter suggests that the current results may be indicative of the formation of a "glass" phase at low temperatures in these mixed systems.

CHEMISTRY

REFER ALSO TO CITATION(S) 3964

4768 Exothermic rate restrictions on electron transfer in a rigid medium. Beitz, J.V.; Miller, J.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **71**: No. 11, 4579-4595(1 Dec 1979).

Many highly exothermic (2—3 eV) electron transfer reactions are shown to be slower than moderately exothermic reactions by factors as large as 10^8. The decrease occurs in a regular way with increasing exothermicity, tending to confirm theoretical predictions of Franck—Condon restrictions on strongly exothermic electron transfer reactions. Deviations from the above trends occur if the reaction product, a molecular anion, has a low-lying electronic excited state into which the reaction may occur with more moderate vibrational exothermicity. Then greatly enhanced rates are found. The rates are enhanced to a lesser extent for acceptors likely to undergo configurational changes upon accepting an electron. These effects are found in measurements of rates of electron tunneling reactions between trapped electrons and 48 organic electron acceptors in rigid 2-methyltetrahydrofuran glass at 77 K. Electron tunneling rates were observed from 10^{-6} to 10^2 s. Measured tunneling distances were 15—40 A. In most cases the observed kinetic decay curves are well simulated by a theory in which the only variable parameter is the effective Franck—Condon factor (F), which is a constant characteristic of the acceptor. For the various acceptors F ranges from 1 to 10^{-5}, and scales the reaction rate at each distance. However in reactions of small vibration exothermicity, the Franck—Condon factors are expected to be very sensitive to small changes in reaction exothermicity caused by relaxations of trapped electrons, which deepen their trap depths with time and, possibly, a dispersion of trap depths. These effects cause F to change with time leading to changes in the shapes of the decay curves. The relationship between the shapes of the decay curves, Franck—Condon factors, and exothermicity allows a semiquantitative interpretation of the present results and much of the earlier tunneling data on electron transfer.

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 4087, 4088, 4089

4769 (NTIS/PS—79/0399) Chemical analysis techniques of trace elements. volume 2. 1976-1977 (a bibliography with abstracts). Report for 1976-1977. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 245p. NTIS PC N01/MF N01.

Research reports on analytical techniques for trace elements are cited. Many of the reports pertain to pollution detection. Some of the techniques include polarography, spectroscopy, gas chromatography, ion exchanging, separation, extraction, distillation, x-ray fluorescence, and neutron activation analysis. (This updated bibliography contains 236 abstracts, none of which are new entries to the previous edition.)

4770 (NTIS/PS—79/0400) Chemical analysis techniques of trace elements. volume 3. 1978-March, 1979 (a bibliography with abstracts). Report for 1978-March 1979. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). May 1979. 175p. NTIS PC N01/MF N01.

This bibliography contains citations describing different chemical analysis techniques and equipment used in trace element analysis. Many of the reports pertain to pollution detection. Some of the techniques include polarography, spectroscopy, gas chromatography, ion exchanging, separation, extraction, distillation, x-ray fluorescence analysis, and neutron activation analysis. (This updated bibliography contains 166 abstracts, 134 of which are new entries to the previous edition.)

4771 Characterizing chemical systems with on-line computers and graphics. Frazer, J.W.; Rigdon, L.P.; Brand, H.R.; Pomernacki, C.L. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Anal. Chem.;* **51**: No. 11, 1739-1747(Sep 1979).

Incorporating computers and graphics on-line to chemical experiments and processes opens up new opportunities for the study and control of complex systems. Systems having many variables can be characterized even when the variable interactions are nonlinear, and the system cannot a priori be represented by numerical methods and models. That is, large sets of accurate data can be rapidly acquired, then modeling and graphic techniques can be used o obtain partial interpretation plus design of further experimentation. The experimenter can thus comparatively quickly iterate between experimentation and modeling to obtain a final solution. We have designed and characterized a versatile computer-controlled apparatus for chemical research, which incorporates on-line instrumentation and graphics. It can be used to determine the mechanism of enzyme-induced reactions or to optimize analytical methods. The apparatus can also be operated as a pilot plant to design control strategies. On-line graphics were used to display conventional plots used by biochemists and three-dimensional response-surface plots.

4772 Characterizing chemical systems with on-line computers and graphics: alkaline phosphatase-catalyzed reaction. Frazer, J.W. (Univ. of California, Livermore); Rigdon, L.P.; Brand, H.R.; Pomernacki, C.L.; Brubaker, T.A. Contract W-7405-ENG-48. *Anal. Chem.;* **51**: No. 11, 1747-1754(Sep 1979).

Computer automation of experimental apparatus can aid in the global characterization of complex systems by rapidly providing large quantities of accurate data. The combination of fast data collection and manipulation provides a means for understanding complex chemical systems that first appear to be medium number systems. We have applied graphical techniques to the study of the alkaline phosphatase-catalyzed hydrolysis of p-nitrophenylphosphate. Three-dimensional Box-type surfaces gave a quick visual summary of the reaction. Model response surfaces were also generated and compared with experimental surfaces to evaluate the model and analytical techniques. Residual-surface graphic techniques that compare experimental and model response surfaces aid in the identification of modeling or experimentation errors. Reaction rate surfaces, which are three-dimensional plots at constant reaction rate, are a new type of graphical representation of use in presenting complex nonlinear systems. Traditional plots and replots are also generated on-line.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 4049, 4051, 4052, 4057, 4065

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 4092, 4093

4773 Copper mercaptides as sulfur dioxide indicators. Eller, P.G.; Kubas, G.J. (to Dept. of Energy). US Patent 4,152,118. 1 May 1979. Filed date 16 Jun 1978. 4p.
PAT-APPL-916,181.

Organophosphine copper(I) mercaptide complexes are useful as convenient and semiquantitative visual sulfur dioxide gas indicators. The air-stable complexes form 1:1 adducts in the presence of low concentrations of sulfur dioxide gas, with an associated color

change from nearly colorless to yellow-orange. The mercaptides are made by mixing stoichiometric amounts of the appropriate copper(I) mercaptide and phosphine in an inert organic solvent.

4774 Computer-assisted controlled-potential coulometric determination of plutonium for safeguards measurements. Holland, M.K.; Frazzini, T.L.; Weiss, J.R.; Pietri, C.E. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 15-16(1979).

4775 (UCRL-Trans—11498) **Use of fluorescent indicators for determination of small quantities of surfactants. I. Determination of organic sulfates and sulfonates.** Dolezil, M. Translated from *Chem. Listy;* **50**: 1579-1592(1956). 7p. Dep. NTIS, PC A02/MF A01.

A titration method for determination of small quantities of organic surface-active sulfates and sulfonates is described in the study that uses quaternary salts of the cetrimonium bromide type and fluorescent indicators to mark the titration stop.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 4049, 4051, 4062, 4064, 4071, 4079, 4101, 4102, 4103, 4108, 4109, 4111, 4112, 4114, 5001

4776 (RFP—2955) **Analysis of Rocky Flats soils for six radionuclides by a sequential method.** Stevens, J.R.; Guhlow, D.R.; Rees, T.F.; Grossaint, K.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 19p. (CONF-791049—15). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A method for the sequential analysis of Rocky Flats soils for six actinides of interest was developed to facilitate the large number of radionuclide analyses. The isotopes determined were: ^{238}U, ^{235}U, ^{234}U, ^{232}Th, ^{230}Th, ^{228}Th, ^{237}Np, /sup 239/240/Pu, ^{241}Am, and ^{244}Cm. The method included addition of tracer isotopes for each actinide, pyrosulfate fusion to help solutize minerals and decompose organic matter, sequential separation by cation and anion exchange techniques, extraction into thenoyltrifluoroacetone (TTA)/organic phase, and subsequent counting of alpha activity by pulse height analysis. The efficiency of recovery for tracer isotopes ranged from 40% for curium, to 95% for plutonium. The detection limits for the method were determined at 0.2 disintegrations per minute per gram (DPM/g) of soil for thorium, uranium, neptunium, and plutonium. The limits were a factor of three higher (0.6 DPM/g) for americium and curium, primarily because of inefficient extraction of these components by TTA. The sequential analysis was developed into a routine laboratory procedure to be used when multi-element soil analyses were requested.

4777 Gamma-ray measurements for uranium enrichment standards. Reilly, T.D. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 6(1979).

4778 New advances in alpha spectrometry by liquid scintillation methods. McDowell, W.J.; Case, G.N. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 8-10(1979).

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 4037, 4051, 4066, 4092, 4094, 4107, 4110, 4113, 4115, 4890, 5020

4779 (UCRL—52810(Pt.1)) **Computer programs in BASIC language for graphite furnace atomic absorption using the method of additions. Part 1. Operating instructions.** Boyle, W.G. Jr.; Ryan, D.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jul 1979. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

These instructions describe how to use BASIC language programs to process data from atomic absorption spectrophotometers using the graphite furnace and the method of additions calibration technique. The instructions cover loading the programs, responding to computer prompts, choosing among various options for processing the data, performing operations with an automatic sampler, and producing reports. How the programs interact with each other is also explained. Examples of computer/operator dialogue are presented for typical cases. In addition, a concise set of operating instructions is included as an appendix.

4780 Nuclear magnetic resonance spectra reduction by electronic modification of the recorder on a 100-megahertz spectrometer. O'Donnell, D.J. (Oklahoma State Univ., Stillwater); Sigle, S.O.; Berlin, K.D.; Sturm, G.P. Contract EW-78-A-19-0001. *Anal. Chem.;* **51**: No. 11, 1886-1888(Sep 1979).

Accumulation of a large number of standard size plots of NMR spectra can cause storage problems. A process has been developed to cause direct reduction of the spectra size by modifications of the control circuit of a Varian XL-100 spectrophotometer. The circuitry and mounting details are discussed. 4 figures.

4781 Preparation of ^{244}Pu standard reference material. Kingston, H.M.; Machlan, L.A.; Gramlich, J.W. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 3(1979).

4782 Nuclear materials analysis using plasma desorption mass spectrometry. Ulbricht, W.H. Jr. (New Brunswick Lab., Argonne, IL). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 5-6(1979).

4783 Quadrupole mass spectrometry for isotopic analysis of uranium hexafluoride. Kusahara, H.S.; Rodrigues, C. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 6-7(1979).

4784 Acid-compensated multiwavelength determination of uranium in process streams. Bostick, D.T. (Oak Ridge National Lab., TN). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 10-11(1979).

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 3983, 4095, 4776

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 4548, 4791

4785 (AD-A—062130) **Chemical reactions that produce electronically excited metal atoms. Final report, 1 March 1975-30 June 1978.** Davidovits, P. (Boston Coll., Chestnut Hill, MA (USA)). 31 Oct 1978. 16p. NTIS PC A02/MF A01.

Techniques have been developed for the study of highly exoergic reactions of boron and carbon atoms. Merged flow, diffusion and single collision experiments were performed to measure total reaction cross sections, chemiluminescence cross sections and population distributions in the electronically excited states of reaction products. The basic purpose of these studies was to gather a body of systematic data in order to understand the reaction mechanism and the production of electronically excited states for this important class of non-metal atom reactions.

4786 (AD-A—062329) **Prospects for dinuclear transition metal chemistry illustrated by recent advances in the chemistry of dimolybdenum and ditungsten. Final report.** Chisholm, M.H. (Princeton Univ., NJ (USA). Dept. of Chemistry). 25 Oct 1978. Contract N00014-76-C-0826. 52p. NTIS PC A04/MF A01.

This manuscript represents both a final report and a technical report. (1) Publications, including those currently in press, acknowledging ONR support are listed. (2) Recent advances in the chemistry of Dimolybdenum and Ditungsten are reviewed. Special emphasis is placed upon the reactivity patterns of dinuclear compounds and the prospects for the future developments in this new area of transition metal chemistry. (Author)

4787 (AD-A—066924) **Basic and applied research in materials. Final report 1 Jul 76-30 Jun 77.** Wagner, J.B. Jr. (Northwestern Univ., Evanston, IL (USA). Materials Research Center). Jun 1977. Contract N00014-75-C-1116,. 16p. NTIS PC A02/MF A01.

Research has been carried out in two areas: heterogeneous catalysis and materials for energy storage. In the first project, standard batches of Pt/SiO_2 catalysts were prepared and characterized utilizing a variety of techniques, e.g., x-ray diffraction, isotopic exchange between deuterium and cyclopentane, etc. The purpose of these studies is to elucidate information on the nature of the catalyst crystallites, the effect of the support upon the catalyst behavior, the effect of metallic particle size on catalytic characteristics and the effect of the method of catalyst preparation upon catalytic activity. The results of the final sets of measurements are presented.

4788 (COO—4694-2) **Low-energy ion-molecule reaction dynamics and chemiionization kinetics. Progress report, February 1, 1979-January 31, 1980.** Farrar, J.M. (Rochester Univ., NY (USA)). 1979. Contract ER-78-S-02-4694. 9p. Dep. NTIS, PC A02/MF A01.

Low energy studies of proton transfer and charge exchange reactions of H_2^+ were begun. A study of H_2^+ (CO, H) HCO^+ was completed in the relative energy range 0.7 to 9.2 eV. Work has been initiated on the systems H_2^+ + He, Ne, Ar, N_2, and O_2. Construction on a tandem-mass spectrometer for the study of associative detachment reactions was begun.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

4789 (MLM—2659) **Gas phase thermal diffusion of stable isotopes.** Eck, C.F. (Mound Facility, Miamisburg, OH (USA)). 1 Nov

1979. Contract EY-76-C-04-0053. 24p. Dep. NTIS, PC A02/MF A01.

The separation of stable isotopes at Mound Facility is reviewed from a historical perspective. The historical development of thermal diffusion from a laboratory process to a separation facility that handles all the noble gases is described. In addition, elementary thermal diffusion theory and elementary cascade theory are presented along with a brief review of the uses of stable isotopes.

4790 (SAN—115/134-1) **Research on nonlinear infrared processes for laser isotope separation and laser development.** Bischel, W.K.; Rhodes, C.K. (SRI International, Menlo Park, CA (USA). Molecular Physics Lab.). 13 Sep 1978. Contract EY-76-C-03-0115-134. 38p. Dep. NTIS, PC A03/MF A01.

Laser development in the 16-μm region has been examined using a two-photon optical pumping scheme. The existing technology of high energy CO_2 lasers is used to create large excited state populations in the $\nu_2 = 2^-$ vibrational mode of NH_3 which then oscillates on a cascading transition at 16μm. We describe in detail the optical pumping of the $(\nu_2,J,K) = (2_1^-,7,5)$ vibrational-rotational level and its subsequent oscillation at 15.82 μm. Output energies at this wavelength were in excess of 1.5 mJ. We also discuss the AC Stark effect and its use in maintaining the two-photon resonance condition during the pumping pulse. We conclude that line tunable two-photon pumped lasers in the region of 16 μm are available alternatives to other 16 μm sources.

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 3983, 4929, 5003

ELECTROCHEMISTRY

4791 **Theoretical and experimental studies of the effects of charging currents in potential-step voltametry.** Miaw, L.H.L.; Perone, S.P. (Purdue Univ., West Lafayette, IN). Contract EG-77-S-02-4263. *Anal. Chem.;* **51**: No. 11, 1645-1650(Sep 1979).

Digital simulations of current-time behavior in potential-step chronoamperometry and in staircase voltametry have been generated which take into account the effects of potential-step charging currents as well as induced charging currents. Results revealed serious distortions of the current signals before four cell-time constants and significant interference from the induced charging current at times between four cell-time constants and 30 cell-time constants. The theoretical predictions were verified experimentally, and the possibility of extracting pure faradaic current from the measured signals was explored. 7 figures, 1 table.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 4892

RADIATION CHEMISTRY

4792 **Mechanism of thermal electron attachment in O_2—C_2H_4, O_2—CO_2, and O_2—neopentane mixtures.** Kokaku, Y.; Hatano, Y.; Shimamori, H.; Fessenden, R.W. (Department of Chemistry, Tokyo Institute of Technology, Meguro-ku, Tokyo 152, Japan). *J. Chem. Phys.;* **71**: No. 12, 4883-4887(15 Dec 1979).

Thermal electron attachment of O_2 in O_2—C_2H_4, O_2—CO_2, and O_2—neopentane mixtures has been investigated at room temperature, using a microwave conductivity technique combined with pulse radiolysis. The measurements have been extended to a higher pressure region (~850 Torr) than previous observations in order to compare them with the results of an electron swarm method at very high pressures. From low pressure data, the values of $(2.0 \pm 0.3) \times 10^{-30}$, $(3.2 \pm 0.3) \times 10^{-30}$, and $(7 \pm 1) \times 10^{-30}$ cm^6/molecule^2 sec are determined for the overall three body attachment rate constants of O_2 with the stabilizing partners C_2H_4, CO_2, and neopentane, respectively. In each case, the effective rate constant continued to increase with increased density and exceeded those predicted by the Bloch—Bradbury mechanism by sizeable amounts. The excess attachment is suggested to involve pre-existing van der Waals complexes such as $(O_2xC_2H_4)$. Some quantitative conclusions which follow from this mechanism are given.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

4793 (COO—1713-78) **Primary reactions of recoiling germanium atoms.** Woods, R.P.; Cohen, B.H.; Gaspar, P.P. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 1979. Contract EY-76-S-02-1713. 15p. (CONF-790965—1). Dep. NTIS, PC A02/MF A01.

From 10. international hot atom chemistry symposium; Loughborough, UK (Sep 1979).

^{79}Ge recoils are made using the (n,2n) reaction. By analogy with Si recoils, two divalent species are suggested as intermediates in the recoil-germane reaction, one formed by H abstraction and the other formed by insertion only. A series of moderator and competition experiments were conducted. Of the noble gases, Kr is the most efficient moderator at removing kinetic energy from the recoils. Xe has a special effect due to its low ionization potential. A reaction scheme is proposed with two routes to digermane, one from a hot neutral atom and the other from a positive ion. 8 figures. (DLC)

4794 (COO—1713-79) **Reactions of recoiling silcon atoms with the methylsilane H/sub n/SiMe/sub 4-n/.** Mo, S.H.; Holten, J.D. III; Gaspar, P.P. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 1979. Contract EY-76-S-02-1713. 28p. (CONF-790965—2). Dep. NTIS, PC A03/MF A01.

From 10. international hot atom chemistry symposium; Loughborough, UK (Sep 1979).

^{31}Si recoils are produced by the ^{31}P(n,p) and ^{30}Si(n,γ) reactions. Two mechanisms for the reaction of Si recoils involve the silylene (SiH_2) and silyl (SiH_3) radicals. Reactions of recoiling atoms and of thermally generated SiH_2 and silylene were studied in parallel. Moderation of recoils by noble gases and NO was also studied. Implications of the results are discussed. (DLC)

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 4976

4795 (RLO/SFM—79-4) **Surplus Facilities Management Program. Plan for decommissioning of Department of Energy radioactively contaminated surplus facilities.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; UNC Nuclear Industries, Inc., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1857. 573p. Dep. NTIS, PC A24/MF A01.

This document presents a recommended plan of action for decommissioning the radioactively contaminated surplus DOE facilities declared surplus prior to October 1, 1976. The plan recommends priorities (project starts) for the disposition of these facilities, based on coordination of the requirements at all the DOE field operations offices. The primary objective of eliminating the present inventory of 486 surplus radioactively contaminated facilities will be achieved, if the plan is followed through to completion in 20 years. The current inventory of surplus radioactively contaminated DOE facilities surplused before October 1, 1976, is included. Comprehensive project descriptions for the 87 projects are also presented. Facilities which were surplused after October 1, 1976, are contained in Appendix A.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

4796 (LBL—9809) **Combustion research. Chapter from the Energy and Environment Division annual report 1978.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 43p. Dep. NTIS, PC A03/MF A01.

The research programs described are aimed at developing a better understanding of the various fluid mechanical and chemical processes which are thought to be of critical importance in reducing pollutant formation. Principal program areas are the interaction of fluid mechanical turbulence with combustion reactions, important phenomena and pollutant generating processes associated with internal combustion engines, fire safety and flame spread, and diagnostics and formation mechanisms associated with the generation of nitrogen containing pollutants.

4797 (PB—291314) **Combustion research on characterization of particulate organic matter from flames. Final task report August 1974-August 1977.** Hites, R.A.; Howard, J.B. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). Aug 1978. 94p. NTIS PC A05/MF A01.

The report gives results of a study of the formation and emission of soot and polycyclic aromatic hydrocarbons (PAH) from both laminar flames and a turbulent continuous-flow combustor. Decreasing the atomizing pressure decreased the amount of soot and PAH produced in the latter system. Benzene fuel gave more soot

and PAH than did kerosene, and the PAH from benzene were more substituted. Nitrogen- and sulfur-doped fuels did not affect total soot production. The distribution of soot and PAH within the flame was consistent with the concept that certain PAH may serve as intermediates in soot formation. The PAH formed during combustion of coal, wood, and kerosene were separated and identified by capillary column gas chromatography and mass spectrometry. The PAH from coal combustion were found to be similar to airborne PAH from Indianapolis, a high coal consumption area; those from kerosene combustion were similar to airborne PAH from Boston, an area of low coal consumption and high consumption of petroleum derived fuels. Nitrogen containing fuels primarily produce polycyclic aromatic compounds in which the nitrogen is in a cyano substituent (approximately 70%). This contrasts with the observation that nitrogen heterocyclic compounds are the major nitrogen containing compounds in airborne particulate matter.

4798 (PB—292522) **Enhanced SO^3 emissions from staged combustion. Final report, July 1977-April 1978.** Merryman, E.L.; Levy, A. (Battelle Columbus Labs., OH (USA)). Jan 1979. 27p. NTIS PC A03/MF A01.

The report gives results of an experimental study to determine if staged combustion can increase (enhance) the SO^3 level in a combustion gas, relative to that observed in a similar single-stage process. Methane flames doped with H^2S were used to examine the staging effects, employing a small quartz tube two-stage combustor. Examination of the staged combustion process suggests that the high CO levels produced in the first stage may pump a sufficient level of oxygen atoms into the second stage to increase SO^3 formation. The results further suggest that the enhancement is small and may only be a transient early postflame phenomenon dependent on several combustion variables. A kinetic analysis of the data yields values of: (k sub 1) = 7.4 x 10 to the 14th power (cm to the 6th power) (mole to the minus 2) (sec to the minus 1) for the SO^3 formation process, $SO^2 + O + M = SO^3 + M$; and (k sub 2) = 1.5 x 10 to the 11th power (cm cubed)(mole to the minus 1) (sec to the minus 1) for the depletion process, $SO^3 + O = SO^2 + O^2$ (T = 1685 K). The kinetic analysis also shows that enhancement of SO3 formation can occur in staged combustion.

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 4611, 4612, 4613, 4616, 4681

4799 (LA—7913-PR) **Magnetic refrigerator development. Progress report, March 1—May 31, 1979.** Barclay, J.A.; Steyert, W.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

The report contains most of the experimental results on the room-temperature, magnetic wheel refrigerator. The results are interpreted and the major problems are outlined. In light of the very small magnetic field in which the refrigerator operated, the refrigerator performed well. Preliminary stages of the experiments on the room-temperature reciprocating magnetic refrigerator are also described.

4800 (NTIS/PS—79/0298) **Heat pipes. Volume 3. March, 1976-March, 1979 (citations from the NTIS data base). Report for March 1976-1979.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 254p. NTIS PC N01/MF N01.

Theory, design, fabrication, testing, and operation of heat pipes are presented in these Federally-sponsored research reports. Applications are described in the areas of heating and air conditioning, power generation, electronics cooling, spacecraft, nuclear reactors, cooling engines, and thermodynamics. (This updated bibliography contains 247 abstracts, 77 of which are new entries to the previous edition.)

4801 (NTIS/PS—79/0299) **Heat pipes. Volume 3. April, 1977-March, 1979 (citations from the Engineering Index data base). Report for April 1977-March 1979.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 214p. NTIS PC N01/MF N01.

Research reports covering the thermodynamics, design, fabrication, and applications of heat pipes are cited from worldwide literature. Applications are described in the areas of electronics cooling, spacecraft thermal control, heat exchangers, heating and refrigeration, and waste heat utilization. (This updated bibliography contains 208 abstracts, 77 of which are new entries to the previous edition.)

4802 (SAND—79-0649C) **Correlation of nosetip boundary-layer transition data measured in ballistics-range experiments.** Reda, D.C. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 16p. (CONF-800104—1). Dep. NTIS, PC A02/MF A01.

From 18. AIAA aerospace sciences meeting; Pasadena, CA, USA (14 Jan 1980).

Preablated nosetips of various carbonaceous materials were tested in a ballistics range. Surface-temperature contours, measured with image-converter cameras, were used to define boundary-layer transition-front contours. Measurements of surface roughness, surface temperature, average transition-front location, and freestream environment were combined with calculations of nosetip flowfields, and with calculations of laminar boundary-layer development in these flowfields, to transform all data into various dimensionless parameters. These parameters were defined by previous attempts to correlate existing wind-tunnel data for transition on rough/blunt bodies. Of the available correlating techniques, only one, based on the concept of a constant (critical) roughness Reynolds number for transition, was found to successfully describe both the wind-tunnel and ballistics-range data, thereby validating the extrapolation of this concept to actual reentry-vehicle materials and environments.

4803 (SAND—79-1940) **Roll control of an attitude-controlled aerodynamic vehicle which has strong roll-yaw coupling.** Perdreauville, F.J. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

Plant equations, autopilot structure and control philosophy are described for the roll control of a vehicle that has destabilizing roll-yaw coupling. Computer-implemented stability analyses and transient responses for two autopilot designs are presented and discussed.

4804 (SAND—79-8060) **Programmable two-axis remote positioner.** Hopwood, J.; Turner, A. (Sandia Labs., Livermore, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

A two-axis mechanical positioner with an electronic controller has been developed for remote control of the wire feed in electron-beam cold-wire welding operations. Control is accomplished through regulation of the rotation and direction of high-speed stepping motors attached to each stage of a two-axis fixture which holds the wire-feed mechanism. The design features manual operation, programmable incremental movement toward and away from the fillet, and programmable wire feed rate. Although developed to fill a specific need for welding operations within a vacuum, it can be considered for use in other applications requiring precise positioning from a remote location. This document details the controls, operation, circuitry, and mechanical hardware.

4805 (SAND—79-8064) **Operating procedure for the eclipse S-200/230 data acquisition/reduction systems.** Folkendt, S. Jr. (Sandia Labs., Livermore, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 98p. Dep. NTIS, PC A05/MF A01.

The Eclipse S-200 (ES200) and S-230 (ES230) are all-digital, stand-alone data acquisition and analysis systems for vibration and shock testing. This document describes the procedure for system power-up, data gathering, and quick-look plotting. It also serves as a user's reference manual to the system.

4806 (SAND—79-8065) **User's manual: secondary data reduction programs for the Eclipse S-200/230 shock and vibration measurement systems.** Swan, H.W. (Sandia Labs., Livermore, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

The manual describes the Eclipse secondary data reduction programs from the user's point of view. These secondary processing routines manipulate the data in ways that are outside the scope of the primary reduction routines. These include logarithms, antilogarithms, and powers of data; polynomial smoothing; dividing and multiplying one data set by another; axis scaling; combination and separation; and others.

4807 (TAC-HP—79-002) **Heat pipe technology: a bibliography with abstracts. Quarterly update, April-June 1979.** Munje, S.; Feldman, K.T. Jr. (eds.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1979. 49p. University of New Mexico, Technology Application Center, Albuquerque, NM 87131.

This is the second quarterly update for 1979 in the Heat Pipe Technology Bibliographic Series. This quarter mainly contains publications on applications and theory. Because of an unusually large number of publications on applications, the second section of this Bibliography is divided into seven subsections instead of five. An author index and permuted title index are included.

4808 (UCRL—82296(Rev.2)) **Prospects for generating 1-10 TPa pressures with a railgun.** Hawke, R.S.; Scudder, J.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1979.

Contract W-7405-ENG-48. 6p. (CONF-790709—4(Rev.2)). Dep. NTIS, PC A02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

It has been demonstrated that a plasma arc can be accelerated along two current carrying parallel rails and used to accelerate a projectile. An extensive analysis found the task of using a railgun to accelerate an impactor plate to velocities of 10 to 40 mm/μs to be feasible with contemporary technology. This range of impact velocities would enable shock pressures of 1 to 10 TPa to be generated for EOS research.

4809 **Dynamic plastic instabilities in stretching plates and shells.** Taylor, J.W.; Harlow, F.H.; Amsden, A.A. (Los Alamos Scientific Lab., NM). *J. Appl. Mech.;* 100: No. 1, 105-110(Mar 1978).

An approximate formulation of the problem of dynamic plastic instability in a thin sheet of material subjected primarily to enertial forces is presented. It is shown that the classic static plastic instability condition reappears with a new and more detailed interpretation. When perturbations are introduced at strain values less than the critical strain, they tend to smooth out in a calculable and rapid rate. When similar perturbations are introduced or remain after the critical strain level is passed, they develop in a calculable way at a progressively accelerated rate. The details depend strongly on whether or not perturbations are themselves work hardened. The size of a critical flaw is related to the strain rate, with the consequence that the definition of quasi-state conditions in the context of the present theory becomes self-evident. The net distortion of the perturbation depends strongly on the rate of expansion of the plate and the size of the perturbation in ways that are shown by analytical and numerical solutions of the equations.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 4486, 4531, 4532, 5174, 5175, 5176

4810 (AD-A—062482) **Self-contained automatic recorder of the dc Josephson current.** Simon, R.W.; Landmeier, P. (California Univ., Los Angeles (USA). Dept. of Physics). 30 May 1978. 12p. NTIS PC A02/MF A01.

A circuit for the automatic recording of the dc Josephson current as a function of magnetic field or other variable has been designed and constructed. The apparatus requires no additional signal processing devices as have techniques for this measurement utilized in the past. Sensitivity to critical current amplitudes corresponding to the appearance of five millivolts across a sensing resistor is attained as well as separate examination of the positive and negative halves of the zero-bias current.

4811 (AD-A—064303) **Theory and design of electrical rotating machinery. Annual report No. 6, 1 November 1977-31 October 1978.** Carr, W.J. Jr. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Dec 1978. Contract N00014-72-C-0432. 24p. NTIS PC A02/MF A01.

The objective of this program is to contribute toward new and improved rotating machines for Naval applications, with emphasis on superconducting machinery. Work has been performed on the theory of ac losses in multifilament superconductors and experiments were made to check the theory. A list of publications and abstracts of scientific papers published under the contract is given.

4812 (AD-A—065148) **Some defence applications of superconductors.** Johnson, A.W. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1978. 25p. NTIS PC A02/MF A01.

Two basic applications of superconductivity are described. The first involves the use of Type II superconductors in magnets, motors and generators to improve efficiency and reduce weight and volume. The second relates to the use of superconducting junctions in magnetometers and gradiometers to provide instruments with very high sensitivity. Possible defence use of superconducting materials in these areas is outlined. A brief review of superconductors and their properties is also given.

4813 (LA-UR—79-2953) **Losses in a built-up conductor for large pulsed coils.** Thompson, J.D.; Wollan, J.J.; Turck, B.; Schermer, R.I. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791102—13). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Hysteretic and pulsed-field loss measurements have been performed on cables built up from a basic Nb-Ti composite conductor. Measurements were performed on the basic composite; on first-level cables, consisting of six soft copper wires twisted tightly around the basic composite; and on second-level cables, fabricated by twisting six first-level cables around either a bare or formvar-insulated center copper wire. Results of the measurements were analyzed in terms of a recent theory by Turck for losses in multifilamentary wires. We found from this analysis that contact resistances between constituent conductors in both first- and second-level cables play an important role in determining the pulsed-field loss values. We have been able to vary the degree of interstrand resistive coupling by compacting the cables and by solder-filling them. When the contact is good, as for solder-filled cables, the losses increase by about a factor of 7.5 for long pulse times relative to non-solder-filled, non-compacted cables. For relatively high contact resistances, as for unsoldered cables, the constituent conductors are more nearly decoupled from each other and the losses are low. From the study we have found that it is possible to produce, in a simple manner, fully-stabilized, high-current cables that exhibit low pulsed-field losses. Such conductors are attractive for application in Tokomak induction heating and energy storage magnets.

PROTECTIVE STRUCTURES AND EQUIPMENT

4814 (LA-UR—79-2891) **Investigation of analytical and experimental behavior of nuclear facility ventilation systems.** Smith, P.R.; Ricketts, C.I.; Andrae, R.W.; Bolstad, J.W.; Horak, H.L.; Martin, R.A.; Tang, P.K.; Gregory, W.S. (Los Alamos Scientific Lab., NM (USA); New Mexico State Univ., Las Cruces (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-791083—1). Dep. NTIS, PC A02/MF A01.

From Specialist meeting on the behavior of offgas and ventilation systems under accident conditions; Karlsruhe, F.R. Germany (24 Oct 1979).

The behavior of nuclear facility ventilation systems subjected to both natural and man-caused accidents is being investigated. The purpose of the paper is to present a program overview and highlight recent results of the investigations. The program includes both analytical and experimental investigations. Computer codes for predicting accident-induced gas dynamics and test facilities to obtain supportive experimental data to define structural integrity and confinement effectiveness of ventilation system components are described. A unique test facility and recently obtained structural limits for high efficiency particulate air filters are reported.

4815 (Y/DX—076) **Part support studies for diamond machining mirrors.** Robinson, S.C.; Gerth, H.L.; Stoneking, J.E. (Oak Ridge Y-12 Plant, TN (USA); Tennessee Univ., Knoxville (USA)). 1979. Contract W-7405-ENG-26. 8p. (CONF-791121—2). Dep. NTIS, PC A02/MF A01.

From Workshop on optical fabrication and testing; Tucson, AZ, USA (5 Nov 1979).

Four techniques were studied in an effort to reduce contour errors generated by the method for mounting mirrors to a spindle. It was determined that the potting-in-rubber and vacuum-fixturing techniques were acceptable if great care was taken in preparing the part, the fixture, and in mounting the part. The edge-clamp technique proved unacceptable in its present form, and time constraints prevented further investigation. The three-point, bolted-support technique produced the best results with the least preparation; however, proper mounting-bolt torque and spindle speed are critical to success. This latter technique has been shown to be acceptable for both center turning and off-axis machining. Figure accuracy levels in the range of 250 to 500 nm (10 to 20 μin) peak-to-valley have been obtained using this technique.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 4855

4816 (CONF-791103—39) **Laboratory-scale shielded cell for ^{252}Cf.** Anderl, R.A.; Cargo, C.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 16p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A shielded-cell facility for storing and handling remotely up to 2 milligram quantities of unencapsulated ^{252}Cf has been built in a radiochemistry laboratory at the Test Reactor Area of the Idaho National Engineering Laboratory. Unique features of this facility are its compact bulk radiation shield of borated gypsum and transfer lines which permit the transport of fission product activity from ^{252}Cf fission sources within the cell to a mass separator and to a fast radiochemistry system in nearby rooms.

4817 (HEDL-SA—1842) **Systematic approach to remote maintenance in the fuels and materials examination facility.** Frandsen, G.B.; Nash, C.R.; Divona, C.J.; May, R.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 11 Nov 1979. Contract EY-76-C-14-2170. 20p. (CONF-791103—41). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Fuels and Materials Examination Facility (FMEF) is systematically analyzed from a remote maintenance standpoint using

functional analysis methods. From the analysis the remote maintainability of equipment is ascertained, required tooling lists are formed, and maintenance downtimes are established. These techniques identify deficiencies or inefficiencies in the early design stage where changes have a minimum impact on cost. Special tooling and fixture requirements are minimized by standardizing remote maintenance design features.

4818 (ORNL/CSD—42) **Comparative method for the evaluation of array reflector materials.** Thomas, J.T. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

A general method for the evaluation of materials as reflectors surrounding array of subcritical units of fissile materials is presented. Applied to the materials used in a Safe and Secure Trailer, it is concluded that the carrier effectiveness as a reflector can be expected to be less than that of a 2.5-cm-thick water reflector.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 4001

LASERS

4819 (AD-A—062091) **A chemical singlet molecular oxygen generator. Final report.** Pritt, A.T.; Coombe, R.D.; Goldberg, I.B.; Pilipovich, D.; Wagner, R.I. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jul 1978. Contract F29601-76-C-0070. 99p. NTIS PC A05/MF A01.

A method of generating a continuous wave (cw) 'clean' stream of oxygen containing a large fraction in the singlet state has been developed based upon the base catalyzed chemical reaction of chlorine fluorosulfate and hydrogen peroxide. After the addition of molecular iodine a fast energy transfer process between O_2 and I created a population inversion between the spin-orbit states of atomic iodine. This population inversion was directly observed in an optical double resonance experiment in which the excited spin-orbit state population was decreased as the transition was driven toward saturation by a pulsed iodine atom laser. The O_2 generator, quantitative diagnostics, optical double resonance experiment, and lasing attempts are described in this report. (Author)

4820 (AD-A—062390) **Fluid mechanical refracting gas prism and aerodynamics of e - beam sustained discharge in supersonic flow, both applicable to laser technology. Interim scientific report 1 January-31 December 1977.** Bogdanoff, D.W.; Christiansen, W.H. (Washington Univ., Seattle (USA)). May 1978. 101p. NTIS PC A06/MF A01.

Details are presented of extensive experimental tests of a 90 degree Venus Machine, a fluid mechanical optical control device which deflects a beam of light continuously through large angles. A motion-picture photographic technique was used to obtain extensive data under a variety of operating conditions on the size and shape of the light well, a region in the flow where light rays are trapped in near circular paths. The angular divergence of the laser beam leaving the Venus Machine was also measured for the same range of operating conditions. These experimental results, along with parallel theoretical work, have allowed a reasonably complete understanding of the operation of the present 90 degree device at low laser power levels and have indicated that potential exists for the design of Venus Machines of much higher performance and optical quality. Construction of a ruby laser and the necessary optical and detector systems for high-power Venus Machine transmission was completed. Preliminary calibration measurements with the detector system were made. Other experimental work is underway to find ways of improving the performance of electron-beam sustained electric discharge lasers. Some considerations include discharge boundary layer interactions and medium homogeneity. Preliminary results of the foundamental mechanisms of the interaction of electrical discharges of the glow type and the fluid mechanics as found in supersonic electric discharge lasers are briefly presented in this report.

4821 (AD-A—063814) **Laser-plasma interaction and ablative acceleration of thin foils at $10^{17}-10^{14}$ W/sq. cm. Memorandum report.** (Naval Research Lab., Washington, DC (USA)). 29 Dec 1978. 53p. NTIS PC A04/MF A01.

The interaction physics and hydrodynamic motion of thin-foil targets irradiated by long, low-flux Nd-laser pulses (3 nsec, 10^{12} to 7 x 10^{14} W/sq.cm) are studied experimentally and compared with theoretical models. Laser light absorption is high (80 to 90%) and thin-foil targets are accelerated up to about 10^{7} cm/sec with good (about 20%) hydrodynamic efficiency in the 0^{12} to 10^{14} W/sq.cm range. These results agree with a simple rocket ablation model. Details of thermal heat flow both axially (related to ablation depth) and laterally (related to beam uniformity requirements) are also presented.

4822 (AD-A—063872) **Experimental investigations of XeF_2 for possible laser applications. Technical report 1 Dec 77-30 Sep 78.** Channell, R.E.; Davis, L.P.; Siegenthaler, K.E. (Frank J. Seiler Research Lab., United States Air Force Academy, CO (USA)). Dec 1978. 20p. NTIS PC A02/MF A01.

The feasibility of the use of xenon difluoride as the oxidant for an HF or DF chemical laser system was investigated. The basic research that was accomplished to provide information for this study included spectral studies, photodissociation and thermal dissociation of the xenon difluoride. The absorption spectrum of xenon difluoride confirmed the literature result. Attempts to detect radical thermal or photodissociation products via electron spin resonance spectrometry were unsuccessful. Due to these negative results it was concluded that xenon difluoride would not be a good candidate for the oxidant in a chemical laser system.

4823 (AD-A—063919) **Design and performance of flowing-gas electrical-discharge CO_2 lasers. Interim report.** Hodges, D.T.; Foote, F.B. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 27 Dec 1978. Contract F04701-78-C-0079. 40p. NTIS PC A03/MF A01.

This report describes the design and construction details of flowing-gas electric discharge CO_2 lasers capable of 750 W TEM sub 00 output power in the 10 micrometers spectral range. Amplitude and frequency stability, lifetime considerations, and general maintenance of the laser are discussed. Detailed engineering drawings, optics requirements, and a parts list are included to facilitate replication.

4824 (AD-A—063937) **Distributed feedback semiconductor injection laser with efficient feedback coupling. Final report, 15 Apr 75-2 Feb 77.** Minden, H. (Sperry Research Center, Sudbury, MA (USA)). Nov 1977. Contract F19628-75-C-0178. 48p. NTIS PC A03/MF A01.

Attempts were made to produce a GaAs diode laser structure suitable for bombardment by 200 keV protons. The objective was to bombard the active region through a fine grating mesh in order to produce lasers whose gain varied periodically along the length of the junction. The requirements for the structure were that the local surface roughness be no more than the order of a wavelength of light, and that the active layer of the structure be within two micrometers of the surface. Difficulties were encountered in making morphologically acceptable layers. However, the resolution of those difficulties gave insight into the limitations of the sliding boat LPE technique. Poor device performance was ultimately attributed to the fundamental device structure rather than surface morphology.

4825 (AD-A—064206) **On the interaction of two high intensity laser beams.** Bhartia, P.; Valluri, S.R. (Defence Research Establishment, Ottawa, Ontario (Canada)). Nov 1978. 24p. NTIS PC A02/MF A01.

With the rapid development of high energy, coherent, monochromatic laser sources is foreseen, the interaction phenomenon between two such sources is of fundamental importance. This work attempts to treat the above interaction by the use of the Lagrangian for a strong electromagnetic field. The quantum mechanical effect of the scattering between plane light waves is simulated within the framework of classical theory under the assumption of an effective nonlinear interaction between the light waves. The scattered fields are solved for, and expressions are obtained for, the scattered power.

4826 (AD-A—064213) **Analytic electron energy distribution functions for electric discharge lasers. Master's thesis.** Gist, T.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 100p. NTIS PC A05/MF A01.

The Boltzmann equation for electrons is solved for background gases of one or two excited levels under conditions typical of electric discharge lasers. Reaction rates are assumed constant above a threshold energy, and the electron heating rate is assumed independent of energy. Elastic and superelastic collisions were not considered. Numerical solutions from a program developed in conjunction with Seward, Hastings, and Ercoline are in excellent agreement with the analytic solutions.

4827 (AD-A—064214) **Analysis of an injection-locked dye ring laser amplifier. Master's thesis.** Vetter, J.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 76p. NTIS PC A05/MF A01.

A rate equation model for an injection locked dye ring laser amplifier is derived. The amplifier is a design by A. Pease et al. The model is compared to work by G. Marowsky, C. Lin, and U. Ganiel et al and is shown to compare very well. The model is then used to analyze the amplifier. The conditions of the amplifier that are varied are the injected wavelength, delay time between the injection and pump pulses, and the mirror reflectivity. Results show that reabsorption of photons at the injected wavelength by the dye has significant effects on looking and that varying the mirror reflectivity partially alleviates this situation. The best delay times are found to be between 3 and 7 ns.

4828 (AD-A—064314) **Beam profiling of a multimode laser. Master's thesis.** Licata, R.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 92p. NTIS PC A05/MF A01.

The experimental investigation into the intensity profile characteristics of a multimode, high-power, continuous-wave, CO_2 laser is presented. Quantitative one-dimensional profiles were obtained using an enhanced swept null point calorimeter. Qualitative two-dimensional profiles were obtained using the IR transparency material -- 3M, Type 577. The results were: the beam divergence is 3.75 mrad; the intensity profile is characterized basically by a circular mode pattern, but superimposed by a distinguishable rectangular component; the rectangular component only varies in intensity proportional to the laser power and inversely proportional to the optical path length; the shot stability is about + or - 7 w/sq cm; and the average profile deviation from an idealized 'flat top' profile varies from 11 to 15%.

4829 (AD-A—067298) **A high-power, free-electron laser based on stimulated Raman backscattering. Interim report.** McDermott, D.B.; Marshall, T.C.; Parker, R.K.; Schlesinger, S.P.; Granatstein, V.L. (Naval Research Lab., Washington, DC (USA)). 16 Feb 1979. 15p. NTIS PC A02/MF A01.

A free electron laser using an intense relativistic electron beam in a rippled magnetic field has been operated in the stimulated Raman scattering regime to yield megawatt-level radiation at submillimeter wavelengths; line-narrowing to Delta lambda/lambda approximately 2% is reported.

4830 (BNL—26737) **Synchrotron radiation problems in storage ring version of FEL.** Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 13p. (CONF-790853—3). Dep. NTIS, PC A02/MF A01.

From ONR workshop on electron generators of coherent radiation; Telluride, CO, USA (13 Aug 1979).

The main properties of synchrotron radiation are reviewed, and a semi-qualitative description of how synchrotron radiation determines the beam emittance in an electron storage ring is given. The importance of synchrotron radiation for the operation of a free electron laser in a storage ring is discussed. (GHT)

4831 **Absorption studies at 193 nm in e-beam excited xenon.** Duzy, C.; Boness, M.J.W. (Avco-Everett Research Laboratory, Inc., 2385 Revere Beach Parkway, Everett, Massachusetts 02149). *Appl. Phys. Lett.;* **35**: No. 12, 903-905(15 Dec 1979).

This study was undertaken in order to determine whether the observed premature 172-nm laser pulse termination in pure xenon was caused by medium absorption. The absorption was measured by probing the e-beam excited xenon with an ArF (193 nm) laser. Analysis of the results indicates that premature pulse termination cannot be explained entirely by the observed medium absorption.

4832 (SAN—1149-T1) **Additive enhancement of short pulse flashlamps.** Shaw, J.F.; Maynard, R.; Lovoi, P. (ILC Technology, Inc., Sunnyvale, CA (USA)). Apr 1977. Contract EY-76-C-03-1149. 52p. Dep. NTIS, PC A04/MF A01.

A key factor in the development of iodine photodisassociation lasers is the improvement of pump lamp efficiency in the 250 to 300 nm pump band at pulsewidths of about 10 μs. Previous work by Gusinow showed that certain metal additives appeared to enhance pump lamp output in the 250 to 300 nm region by as much as a factor of three. This had been determined by comparing microdensitometer traces of spectrograms of doped and undoped lamps. The principal problems noted with these lamps were a shot-to-shot variability of more than 30% and an effective life of only 20 shots (a result of migration of the dopants from between the electrodes to the colder regions behind the electrodes).

4833 **Operating characteristics of a closed cycle flow rare gas halide laser.** Miller, J.L.; Dickie, J.; Davin, J.; Swingle, J.; Kan, T. (University of California Lawrence Livermore Laboratory, Livermore, California 94550). *Appl. Phys. Lett.;* **35**: No. 12, 912-914(15 Dec 1979).

A UV preionized, high-purity construction, closed-cycle-flow rare-gas-halide laser has been constructed to study laser characteristics at high pulse repetition frequency and closed cycle behavior of the laser chemistry. Operating characteristics of the laser with ArF, KrF, XeF, and XeCl have been obtained. The XeCl laser has demonstrated the best performance, yielding a maximum average power of 45 W at 600 Hz and greater than 35 W at 500 Hz for 1 h.

HEAT TRANSFER AND FLUID FLOW

4834 (LBL—9905) **Gas-particle flow in the entry region of a curved pipe.** Yeung, W.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 100p. Dep. NTIS, PC A05/MF A01.

Thesis.

The flow of a dilute gas-particle mixture entering a circular curved pipe was investigated. The fluid is assumed to be incompressible and the flow nonseparating and laminar. Individual numerical schemes were devised to handle the two different regions of the fluid flow field, i.e., the irrotational core region and viscous boundary layer region. Interaction between the two regions is also accounted for by means of a simple iteration scheme. Final results are presented and compared with other theoretical and experimental results. Since an irrotational core is assumed, the uniform entry profile changes to a two-dimensional potential vortex shortly downstream of the entry section. This is consistent with published experimental data. There is also a cross flow directed from the outer bend towards the inner bend in the immediate neighborhood of the entry section. Further downstream, the cross flow reverses its direction and moves from the inner bend towards the outer bend. The axial profile, however, does not change drastically from that of a uniform profile because of the weak interaction between the core and boundary layer region for the values of Reynolds number considered, ($10^4 \sim 10^5$). The dynamics of the particle phase are discussed. Lagrangian equations of motion for the particle phase are used. Due to the complexity of the momentum coupling between the two phases (i.e., the gas phase and the particle phase), only the first order solution for the particle phase were obtained by neglecting its effect on the gas flow field. This has been proved adequate, for example in the erosion calculation of a curved pipe carrying a gas-solid mixture. Asymptotic expansion solutions for the particle trajectories are discussed. Finally, the density of the particle at the pipe wall is presented and the numerical results are discussed.

4835 **Solidification of a liquid penetrating into a convectively cooled tube.** Epstein, M.; Hauser, G.M. (Argonne National Lab., IL). *Lett. Heat Mass Transfer;* **5**: No. 1, 19-28(1978).

Solidification of a liquid at its fusion temperature as it penetrates into an initially empty tube maintained at constant temperature was treated theoretically and experimentally. An approximate method was introduced which involves postulating a reasonable functional form for the instantaneous shape of the frozen layer along the tube wall. This approximate crust profile method was verified theoretically using a numerical approach in which the governing integro-differential equation of liquid motion was rigorously solved on a digital computer. The good agreement obtained between the numerically exact solution and the crust profile assumption in the special case of constant wall temperature encourages exploitation of the crust profile method to predict the effects of a finite heat transfer coefficient when the flow tube is immersed in a liquid coolant bath. This system has been used in previous experimental studies of freezing of an advancing flow.

MATERIALS TESTING

4836 **Bayesian model for determining the optimal test stress for a single test unit.** Martz, H.F. Jr.; Waterman, M.S. (Los Alamos Scientific Lab., NM). *Technometrics;* **20**: No. 2, 179-185(May 1978).

Consider the case of a single test unit which must be tested at some level of test stress. Suppose that the test stress level is free to be determined, and that only the survival or nonsurvival of the unit is observed. It is assumed that the unit is designed to withstand a known and specified design stress level. A Bayesian model is developed for determining the required level of test stress which maximizes the expected probability of survival at the design stress level. Engineering experience from similar past tests on similar units is used to fit the model. A practical application illustrates the method. The sensitivity of the procedure to changes in the parameters used in fitting the model is also examined.

ELECTRONIC CIRCUITS AND DEVICES

4837 (SAND—79-1487) **High-temperature complementary metal oxide semiconductors (CMOS).** McBrayer, J.D. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 58p. Dep. NTIS, PC A04/MF A01.

Silicon CMOS devices were studied, tested, and evaluated at high temperatures to determine processing, geometric, operating characteristics, and stability parameters. After more than 1000 hours at 300°C, most devices showed good stability, reliability, and operating characteristics. Processing and geometric parameters were evaluated and optimization steps discussed.

4838 (UCID—18298-79-2) **Computer program newsletter. Number 2.** Magnuson, W.G. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 48p. Dep. NTIS, PC A03/MF A01.

This issue of the computer program (code) newsletter focuses on electrical network analysis using digital computer programs. In

particular, five network analysis programs are described (SCEPTRE, SPICE2, NET-2, CALAHAN, and EMTP). The objective of the program descriptions in this newsletter is to provide a very brief description of the input syntax and semantics, highlight the strong and weak points, and illustrate how the programs can be used at Lawrence Livermore Laboratory.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 3989, 4007

4839 Apparatus for individual controlled distribution of powdered solid fuel to plural burning units. Lingl, H. Jr.; Denison, D.E. (to Lingl Corporation). US Patent 4,131,072. 26 Dec 1978. Filed date 26 May 1977. 8p.

Apparatus is disclosed for individually and independently controlling the distribution of powdered solid fuel to each of a plurality of individual burners. A plurality of fuel outlet ports respectively and individually corresponding to individual ones of the plural burners are aligned with and spaced from a respectively corresponding plurality of air outlet ports. The air outlet ports are individually and controllably supplied with pressurized air while a supply of powdered solid fuel is fed into the spaces between the fuel outlet ports and the air outlet ports. In the preferred embodiment, a baffle is disposed between each pair of respectively corresponding fuel outlet and air outlet ports. 16 claims.

4840 Analysis of the pulse combustion burner. Ahrens, F.W.; Kim, C.; Tam, S.W. (Argonne National Lab., IL). *ASHRAE Trans.;* **84**: 488-507(1978).

The analysis presented attempts to establish the manner in which pulse combustion burner performance is influenced by the principal design parameters (combustion chamber volume, exhaust pipe length and diameter, gas valve flow parameters and air/fuel ratio). The analytical model developed defines the unique operating point of the burner in terms of these parameters. Specifically, the frequency, peak pressure and firing rate are predicted by the model. Comparisons of predicted results with experimental data from AGA are presented; the frequency agreement is good, the firing rate relationships are qualitatively in agreement, and the peak pressure comparisons are partially successful. The limitations of the model and suggestions for its improvement are discussed. The results suggest that the combustion chamber and tailpipe dimensions have a significant effect on burner frequency, while the air and gas valve sizes have the greatest effect on burner firing rate and, through their effect on air-fuel ratio, on the peak pressure in the combustion chamber.

UNDERGROUND ENGINEERING

4841 (BEFO—18-2/79) **Optimal site investigations.** Helfrich, H.; Bergman, M.; Carlsson, A.; Franzen, T.; Granlund, N.; Nord, G.; Palmqvist, K.; Stanfors, R. (Stiftelsen Bergteknisk Forskning, Stockholm (Sweden); Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). Apr 1979. 226p. (In Swedish). Dep. NTIS (US Sales Only), PC A10/MF A01.

Site investigations were evaluated by comparing support prognoses with encountered conditions and actual support measures for six Swedish underground projects. It was found that the possibilities for estimating the geohydrological conditions, the leakage and the need of sealing were small.

4842 (PB—289491) **Acceptability guidelines for performance characteristics of underground pager telephones. Open file report.** Long, R.G. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Apr 1977. Contract J0166085. 55p. NTIS PC A04/MF A01.

The report presents recommended acceptability guidelines of design, construction, and performance criteria for pager-type telephones to be used in underground mines. The guidelines are intended for use by manufacturers, inspectors, certification facilities personnel, and mine operating personnel to judge the acceptability of a pager phone for use in an underground mine environment.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 4899, 4900, 4907, 4931

4843 (PB—289941) **Environmental assessment of coal-and oil-firing in a controlled industrial boiler. Volume II. Comparative assessment. Final task report May 1977-July 1978.** Leavitt, C.; Arledge, K.; Shih, C.; Orsini, R.; Hamersma, W. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Aug 1978. Contract EPA-68-02-2613. 169p. NTIS PC A08/MF A01.

A comparative multimedia assessment of coal firing and oil firing in an industrial boiler was conducted. The assessment consists of several parts. First, comprehensive emissions assessments of each fuel were conducted. These comprehensive emissions assessments were used to develop a comparative emissions assessment. This assessment examines the differences in the quantities and character of the emissions resulting from the combustion of each fuel. Comprehensive sampling and analysis of gaseous, liquid, and solid emissions from the boiler and its control equipment were conducted to identify criteria pollutants and other species. The report consists of three volumes. This volume, Volume II, presents the comparative assessments. Included are a description of the test setting, the comparative emissions assessment, and the comparative environmental societal and energy impact assessment.

4844 (PB—289942) **Environmental assessment of coal-and oil-firing in a controlled industrial boiler. Volume I. Executive summary. Final task report May 1977-July 1978.** Leavitt, C.; Arledge, K.; Shih, C.; Orsini, R.; Hammersma, W. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Aug 1978. Contract EPA-68-02-2613. 28p. NTIS PC A03/MF A01.

The report gives results of a comparative multimedia assessment of coal versus oil firing in a controlled industrial boiler. Relative environmental, energy, economic, and societal impacts were identified. Comprehensive sampling and analyses of gaseous, liquid, and solid emissions from the boiler and its control equipment were conducted to identify criteria pollutants and other species. Major conclusions include: (1) While the quantity of particulates from oil firing is considerably less than from coal firing, the particles are generally smaller and more difficult to remove, and the concentration of particulates in the treated flue gas from oil firing exceeded that from coal firing. (2) NOx and CO emissions during coal firing were about triple those during oil firing. (3) Sulfate emissions from the boiler during coal firing were about triple those during oil firing; however, at the outlet of the control equipment, sulfate concentrations were essentially identical. (4) Most trace element emissions (except vanadium, cadmium, lead, cobalt, nickel, and copper) were higher during coal firing. (5) Oil firing produces cadmium burdens in vegetation approaching levels which are injurious to man; coal firing may produce molybdenum levels which are injurious to cattle. (6) The assessment generally supports the national energy plan for increased use of coal by projecting that the environmental insult from controlled coal firing is not significantly different from that from oil firing.

4845 (PB—292648) **Performance and economic evaluation of a hot-side electrostatic precipitator. Final report, December 1976-September 1978.** Marchant, G.H. Jr; Gooch, J.P. (Southern Research Inst., Birmingham, AL (USA)). Nov 1978. Contract EPA-68-02-2185. 195p. NTIS PC A09/MF A01.

The report gives results of measurements--to determine the overall mass and fractional collection efficiency of a hot-side electrostatic precipitator (ESP)--across 1 chamber of a 16-chambered ESP. Measurements of fractional efficiency were conducted across the entire ESP. In situ and laboratory resistivity measurements were performed, and voltage-current characteristics of the power supplies were obtained. An engineering analysis was conducted, including an estimate of the specific collecting area required for a cold-side ESP on the same boiler. Results include: (1) voltage waveforms and secondary voltage-current relationships showed characteristics similar to back-corona although fly ash resistivity was 5 x 10 to the 9th power ohm-cm at 350 C (in situ determination); (2) ESP operation was sensitive to resistivity variation in a resistivity region (2 x 10 to the 10th power to 8 x 10 to the 8th power ohm-cm from laboratory determinations) where no sensitivity was expected; (3) overall mass collection efficiency of an isolated chamber was 99.22% for a specific collection area of 52.6 sq m/(cu m/sec), average secondary voltage was 22 kV, and average secondary current density was 40 nA/sq cm; and (4) the turnkey cost of the ESP system was estimated at $34,940,000 ($44/kW) in 1977 dollars.

POWER CYCLES

RANKINE

4846 (STU—77-7226) **Studies of the efficiency of a Rankine system.** Persson, S.G.; Karlsson, K.; Gimstedt, L.; Edqvist, L. (SAAB-SCANIA, Linkoeping (Sweden)). Oct 1978. 67p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The aim of study was to find the factors that are important for the effectiveness of a traction system working in the Rankine mode, and to suggest technically feasible and economically reasonable measures to improve it. The project has included simulations, testing and analysis. It is concluded that the efficiencies that can be reached with simple steam systems (16 to 20%) are not high enough to get a good fuel economy. Advanced systems with better efficiency will probably be too expensive to be cost-effective.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 4977

4847 (PUB—5031) **Ion induction linac 500 joule test bed.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 49p. Dep. NTIS, PC A03/MF A01.

This proposal presents the design of the Test Bed and the engineering development on crucial components, and describes the experimental and theoretical program that will answer uncertainties regarding beam behavior. The 160 meter-long Test Bed will accelerate Cs^{+1} at a beam charge of 20 micro-coulombs. The ions will originate from a large contact ionization source and transit through two drift tubes before injection into the approximately 80 induction modules of the linac. The output energy will be 25 MeV. The Test Bed will be located on a long pad behind an existing building on the LBL site. Depending on the funding schedule, the project could span from 30 to 44 months, as described in the Cost and Schedule section.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

4848 (ORNL/CSD/TM—94) **TORCAPP: time-dependent cyclotron orbit calculation and plotting package.** Maddox, L.B.; McNeilly, G.S. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 52p. Dep. NTIS, PC A04/MF A01.

TORCAPP calculates the motion of charged particles in electromagnetic fields with time as the independent variable, and produces a variety of printed and plotted output of results. Finite-size beam behavior is studied conveniently by following groups of particles which define an appropriate phase space area. Since time is the independent variable, general motion in the near-median-plane region may be followed. This includes, for example, loops not enclosing the origin and strongly radial motions. Thus, TORCAPP is particularly useful for injection studies for isochronous cyclotrons, or other devices with near-median-plane charged particle motion.

AUXILIARIES AND COMPONENTS

EXPERIMENTAL FACILITIES AND EQUIPMENT

4849 (ANL-PHY—79-2) **Study of a national 2 GeV continuous beam electron accelerator.** (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 60p. Dep. NTIS, PC A04/MF A01.

Current trends in research in medium energy physics with electromagnetic probes are reviewed briefly and design objectives are proposed for a national continuous beam 2 GeV electron accelerator. Various types of accelerator systems are discussed and exploratory designs developed for two concepts, the linac-stretcher ring and a modified microtron system. Preliminary cost estimates indicate that a linac-ring system which meets all the design objectives and uses state-of-the-art technology can be built for approximately $25 million. However, the double-sided microtron shows promise for development into a substantially less expensive facility. Its technical feasibility remains to be established. Proposals are presented for short term research projects directed at specific areas of uncertainty in each of the conceptual designs.

4850 (BNL—26732) **Plants for H^- acceleration in the AGS Linac.** Barton, D.S.; Witkover, R.L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-790927—27). Dep. NTIS, PC A02/MF A01.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Since its commissioning in 1970, the 200 MeV Linac at the Brookhaven AGS has been capable of producing peak proton beam current of greater than 100 mA with pulse lengths up to 300 μsec at a repetition rate of 10 pulses/second. The linac typically runs at 5 pulses per second, providing a 60 mA pulse of 120 μsec duration every 1.6 to 2.4 seconds for conventional multiturn injection into the AGS. The intervening pulses of length up to 300 μsec are used by the radio-isotope production, chemistry and medical facilities. Preparations are now being made to inject and accelerate H^- ions in order to implement charge exchange injection into the AGS. This paper describes the aspects of this work leading to an H^- beam at 200 MeV.

4851 (BNL—26733) **Operation of the Brookhaven 200 MeV Linac.** Fewell, N.M.; LoDestro, V. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790927—26). Dep. NTIS, PC A02/MF A01.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

During the past three years the 200 MeV linear accelerator has continued to operate at a high level of performance and reliability. The linac output beam current has been limited to 60 mA in order to obtain the maximum rf power tube life without compromising the output performance of the AGS. Despite a reduction in pulse repetition rate, total beam current to the BLIP facility has increased to an average of 300 mA hours/year.

STORAGE RINGS

REFER ALSO TO CITATION(S) 4830

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 4514

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 4497

4852 (LA—7970-MS) **Investigation of the use of position sensitive detectors with a magnetic spectrometer.** Olson, R.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

A position sensitive detector is a solid-state sensor having unique properties which allow it to determine the position of the incident particle. An attempt is made to evaluate the usefulness of this type of detector in conjunction with a particle magnetic spectrometer.

4853 **Instrumentation development for the enhanced utilization of calorimetry for nuclear material assay.** Fellers, C.L.; Rodenburg, W.W.; Birden, J.H.; Duff, M.F.; Wetzel, J.R. (Monsanto Research Corp., Miamisburg, OH). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 18-19(1979).

4854 **Experimental comparison of the active well coincidence counter with the random driver.** Menlove, H.O.; Ensslin, N.; Sampson, T.E. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 19(1979).

4855 **In-line plutonium glove-box filter holdup monitor.** Li, T.K.; Marshall, R.S. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 26(1979).

4856 **In-plant evaluation of a uranium NDA system.** Baxman, H.R.; Langner, D.G.; Sprinkle, J.K.; Sampson, T.E.; Canada, T.R. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 27-29(1979).

4857 **Passive nuclear material detection in a personnel portal.** Gould, D.J. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 30-31(1979).

RADIATION DOSEMETERS

4858 (AD-A—064192) **Response of MNOS devices to neutrons and gamma rays. Master's thesis.** Coloney, S.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 58p. NTIS PC A04/MF A01.

Metal-Nitride-Oxide-Semiconductor (MNOS) transistors were evaluated as radiation dosimeters in the neutron-gamma radiation field of a nuclear reactor as compared to their behavior when exposed to gamma rays from a calibrated 60Co source at 40.3 krads (Si) per hour. Their response to gamma rays confirmed the results of a previous study concerning the change in the threshold voltage for conduction, Delta V sub I. For gamma irradiation, Delta V sub TMAX approaches about 5 volts at an exposure of about 4 Mrads (Si). Response to reactor radiation follows the same relation except for an anomalous increase of approx. 20% in Delta V sub TMAX. When shielded with cadmium, Delta V sub T upon repeated irradiation is reproducible within 2% for four runs. When unshielded, a small parallel offset in Delta V sub T results. The devices have survived neutron fluences of 1.9 10 to the 16th power sq cm. After irradiation in the reactor, the responses of two devices to gamma rays were within 5% of pre-irradiation values. A simple schematic is

given for the testing circuit along with procedures to follow to determine gamma ray doses from the MNOS device.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 4976

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

4859 (AD-A—065161) **Hardness assurance guidelines for displacement effects for bipolar devices. Report for July 1977-March 1978.** Berger, R.A. (IRT Corp., San Diego, CA (USA)). May 1978. Contract DAAG39-77-C-0135. 115p. NTIS PC A06/MF A01.

The objective of this document is to provide an effective means of obtaining semiconductor devices whose neutron-induced response is within known and acceptable limits. The scope of the effort was limited to those procedures for the neutron environment for bipolar transistors, zener diodes, TTL (54/74) series digital integrated circuits, 741-type operational amplifiers, and junction field effect transistors. The objective is met by imposing two levels of Hardness Assurance controls on both the supplier and the user. The supplier levels are called control levels, whereas for the user they are quality levels. For the supplier the difference between levels 1 and 2 are the numbers of Hardness Assurance controls to which the part is subjected in order to be qualified (control level 2 requires screens and process controls, and level 1 is achieved by adding inspection lot radiation tests. For the user, the difference between quality levels 1 and 2 is their lot quality, i.e., the percent of devices in each lot which pass the failure criteria. In level 2 lots, > or = 80 percent of the devices will pass the K sub D criteria with 90 percent confidence. Level 1 screening is designed such that 99.9 percent of the devices in bipolar transistor lots will pass.

4860 (AD-A—065162) **Hardness assurance for neutron-induced displacement effects in semiconductor devices. Final report.** Berger, R.A. (IRT Corp., San Diego, CA (USA)). 22 May 1978. Contract DAAG39-77-C-0135. 37p. NTIS PC A03/MF A01.

The objective of this program phase was to provide an effective means of purchasing semiconductor devices whose neutron-induced response is within known and acceptable limits. The scope of the effort was limited to those procedures for the neutron environment for bipolar transistors, temperature-compensated reference diodes, TTL(54/74) series digital integrated circuits, 741-type operational amplifiers and junction field effects transistors(JFET's). This final report covers the method by which the program objectives were met and provides background information for the companion document 'Hardness Assurance Guidelines for Displacement Effects for Bipolar Devices' (HDL-CR-78-135-1). Specifically this final report covers background lot sample statistical methods, assesses existing CRIC experimental neutron device data, and provides the background rationale for the selection of the Hardness Assurance controls.

4861 (AD-A—065186) **Non-localized impact ionization in semiconductors. Final report, 1 August 1974-31 July 1977.** Crowell, C.R.; Kao, C. (University of Southern California, Los Angeles (USA)). Feb 1979. 13p. NTIS PC A02/MF A01.

Studies have been directed towards improving the understanding of the 'nonlocalized' nature of impact ionization: i.e., the fact that carriers must be field accelerated by at least the threshold energy for impact ionization before they can create an electron-hole pair. Work has been directed specifically towards GaAs and InP in Schottky barrier configurations. For GaAs, studies have shown that momentum and energy conservation impose an effective density of available states that grows as the 2 1/2 power of the energy in excess of threshold as opposed to the 3 1/2 and 5 power alternatives. It has also been that the capture cross sections that we can deduce from cascade production by high energy primary radiation are consistent with the modeling needed for the ionization coefficient. This problem was investigated using a Markov formulation and the results of the energy required per pair produced are strongly influenced by the ratio of pair production cross section to phonon scattering cross section at a primary energy of twice the threshold energy. The energy dependence about this energy serves mainly to perturb the result.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 4002, 4037, 5045

4862 (DPSPU—79-30-14) **Completely contained and remotely operated digital density meter.** Goergen, C.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Oct 1979. Contract EY-76-C-09-0001. 13p. (CONF-791103—34; CONF-791049—11). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A completely contained and remotely operated density determination system having unique features was designed, fabricated, and installed at the Savannah River Plant. The system, based on a Mettler calculating digital density meter, provides more precise and accurate results than the falling drop technique for measuring densities. The system is fast, simple, easy to operate, and has demonstrated both reliability and durability.

4863 (RTI—162/00-01F) **Coal Environmental Research Project. Final report.** Nichols, D.G. (Research Triangle Inst., Research Triangle Park, NC (USA). Energy and Environmental Research Div.). 31 Jul 1979. 30p. North Carolina Energy Institute, Research Triangle Park, NC.

The specific intent of this project is to obtain equipment for the experimental determination of physical and chemical properties which can characterize the use and emission potential of fossil fuel energy supplies. The informational output will include physical properties, chemical reactivities and rate constants, and a variety of other characterization parameters. These will be available to government and private sector users in order to more effectively evaluate the potential energy value and environmental impacts associated with specific fossil fuel resources. After an extensive background literature study and evaluation of alternative available equipment, a thermal analysis system including thermogravimetric analyzer, differential thermal analyzer, and differential scanning calorimeter was chosen as the most useful equipment for this project. These equipment items have been purchased, received, and installed for use. Initial experimentation involves studies on the proximate analysis, devolatilization characteristics, heats of reaction, and chemical kinetic rate constants. The utilization of this equipment will generate a variety of outputs relating to the energy and environmental aspects of fossil fuels and related materials. A physical and chemical property data bank plus guidelines for the utilization of these data are also to be developed.

4864 **Tamper recorder for unattended safeguards instruments.** Smathers, D.C. (Sandia Labs., Albuquerque, NM). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 23-24(1979).

4865 **Automated in-line measurement of nuclear fuel pellets.** Nyman, D.H.; McLemore, D.R. (Westinghouse Electric Corp., Richland, WA). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 29-30(1979).

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 4060

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

4866 (LA-UR—79-2768) **Progress in modeling card gap tests.** Bowman, A.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790975—3). Dep. NTIS, PC A02/MF A01.

From CPIA-JANNAF combustion conference; Monterey, CA, USA (10 Sep 1979).

The current status of the numerical modeling of card gap tests is described. The LASL standard test has been modeled with good agreement between calculated and experimental values for PBX-9404 and TATB. The NOL standard test has also been modeled but with very poor agreement for VTQ-2.

4867 (LA-UR—79-2880) **Introduction to detonation phenomena.** Davis, W.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 33p. (CONF-791084—1). Dep. NTIS, PC A03/MF A01.

From Meeting on detonation phenomena; Menlo Park, CA, USA (23 Oct 1979).

The paper serves as an introduction to detonation phenomena for scientists who work in other fields. (TFD)

4868 (MHSMP—79-49) **Skid sensitivity of LX-10-1 as a function of density and billet tilt.** Crutchmer, J.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Aug 1979. Contract EY-76-C-04-0487. 13p. Dep. NTIS, PC A02/MF A01.

A skid test series was conducted on LX-10-1 billets at both the normal density of 1.86 Mg/m^3 and at the lower density of 1.83 Mg/m^3. Results indicate the low density material is slightly less skid

sensitive than normal density billets. Effects of billet tilt were also investigated using the standard density billets. A forward tilt of 20° did not affect the results while a 33° tilt produced a significant increase in sensitivity at the 45° drop angle.

4869 (SAND—79-1653C) **Intermediate range explosion airblast propagation measurements.** Reed, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 17p. (CONF-791130—1). Dep. NTIS, PC A02/MF A01.

From 98. meeting of the Acoustical Society of America; Salt Lake City, UT, USA (30 Nov 1979).

Several hundred explosions of TNT, ranging in weight from 23 kg to 1145 kg were fired at the NASA Space Center, Florida. Comprehensive meteorological measurements were made by rawinsonde balloons and on a nearby 150 m tower, including winds, turbulence, temperatures, and humidity. A cruciform array of airblast gages were operated, with gages at 200 m, 500 m, 1 km, 2 km, and 5 km ranges from the explosions. Airblast results will be correlated against refractive atmospheric conditions, in hopes of establishing a functional relationship between overpressure decay with distance and the sound velocity gradient with height. Preliminary results of the analyses are presented.

4870 (UCID—18313) **Feasibility study on continuous processing of castable plastic-bonded explosives. Interim report, completion of Phase I.** Scribner, K.J.; Magness, F.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

In September 1979, the Lawrence Livermore Laboratory submitted an unsolicited proposal to investigate and demonstrate the feasibility of continuous processing of castable plastic-bonded explosives. The proposal was for a three-year effort. The first year, at a very modest expenditure, would be devoted to research on what has been done in the past, who is currently working in the field, and what modern technology is being applied. The proposal suggests an approach to continuous processing, which has not been considered before. Therefore, it is also necessary to do some preliminary engineering design of the type of equipment that would work best in this application. According to the proposal, the next two years would be devoted to engineering, equipment procurement, materials evaluation, development of processing techniques, and a demonstration run. The second and third years are to be at a much higher level of effort. The report covers only the first year's effort.

NUCLEAR

4871 (AD-A—063934) **The nuclear air-shock precursor: a study of the contribution of airblast-generated seismic waves. Master's thesis.** Price, R.N. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 112p. Availability: Microfiche copies only.

The coupling into the ground of airblast energy from an atmospheric nuclear burst is postulated as a mechanism which may contribute to, if not independently cause, the observed airshock precursor. A computer model to test the hypothesis is constructed by assuming an elastic ground medium, applying finite difference techniques to the equations of motion, and using the space- and time-varying overpressure from the nuclear burst to induce the seismic motions within the ground. The surface velocities resulting from simulation of a 28 kiloton atmospheric burst at 500 feet height of burst yielded a dust layer ballistically reaching only 0.64 cm at its highest point for the stiff one-layer ground medium, 0.096 cm for the softer one-layer medium, and a negligible height for the more realisitic four-layer Frenchman Flats medium. Thus, the airblast-induced precursor as postulated (ballistic rise only) fails to re-create the 2 - 3 meter high dust layers observed in experimental atmospheric nuclear testing. However, the motions are felt to be significant enough to be included in any attempt to model from first principles the precursor and the up-sweep of dust behind the shock front.

4872 (AD-A—064134) **Aerodynamic accounting technique for determining effects of nuclear damage to aircraft. Volume I. Empirical methods. Final report, 15 March 1977-30 January 1978.** Schemensky, R.; Howell, G. (General Dynamics/Fort Worth, TX (USA)). 28 Feb 1978. Contract DNA001-77-C-0075. 230p. NTIS PC A11/MF A01.

This volume presents the methods, equations and substantiating data for an empirically based computer program which calculates lift, moment, and drag characteristics of an undamaged baseline aircraft in addition to calculating the aerodynamics of an aircraft which has sustained nuclear damage. The input requires a simple definition of the basic undamaged configuration geometry along with parameters specifying the mode of damage, magnitude, and dimension of the damaged area. Up to fourteen different modes of damage can be specified which can model most types of damage. The computer code has the capability of assessing the aerodynamics effects of damage, such as rough, bent, and burnt skins, boundary-layer thickness effects, and loss of radomes, panels, doors and covers. Also, the computer code has the capability of analyzing changes in drag due to lift and trim caused by asymmetric loss of parts of the wing or trim surfaces. The accuracy of the program is verified through comparisons of the predicted results with experimental data for several configurations.

4873 (AD-A—064135) **Aerodynamic accounting technique for determining effects of nuclear damage to aircraft. Volume II. Program user guide. Final report, 15 March 1977-30 January 1978.** Schemensky, R.; Howell, G. (General Dynamics/Fort Worth, TX (USA)). 28 Feb 1978. Contract DNA001-77-C-0075. 253p. Availability: Microfiche copies only.

This volume describes the computer program developed for the aerodynamic evaluation of aircraft, including the effects of roughness and damage. The computer code has the capability of assessing the aerodynamic effects of damage, such as rough, bent, and burnt skins, boundary-layer thickness effects, and loss of radomes, panels, doors and covers. Also, the computer code has the capability of analyzing changes in drag due to lift and trim caused by asymmetric loss of parts of the wing or trim surfaces. The computer program is coded in the FORTRAN Extended Version IV language to operate on a CDC 6600 or CYBER 172 computer. The computer code structure is explained and a computer code input utilization is presented along with sample input and output with a FORTRAN source deck listing. Details of the methods, equations, and substantiating data for this computer code are contained in Volume I.

4874 (AD-A—065388) **Wind-tunnel shock-tube simulation and evaluation of blast effects on an engine inlet. Final report, October 1975-December 1977.** Ruetenik, J.R.; Smiley, R.F. (Kaman Avidyne, Burlington, MA (USA)). 15 Mar 1978. Contract DNA001-76-C-0107. 240p. NTIS PC A11/MF A01.

This report describes a program for simulating blast wave intercepts with a scaled aircraft engine in subsonic flight, using the shock tube technique for firing the blast-type waves. Three large 22.6 inch-diameter shock tubes were installed in the AEDC 16T (16 ft sq) transonic wind tunnel and were used to project blast waves at a 0.1-scale B-1 aircraft model. Forty-five firings were made, covering tunnel speeds of Mach 0, 0.55, 0.70, 0.85 and 0.90, blast overpressures (scaled to 1 atm. ambient pressure) from 2 to 6 psi, 0 deg and 5 deg yaw, and inlet flow rates representative of cruise and maximum power conditions. The model inlets were instrumented with 40 combination steady-state and dynamic total-pressure probes at each engine face section and other dynamic transducers to measure incident blast wave properties and inlet internal ramp and cowl pressures. Calculations of blast pressures in the inlets made with the KA BID code satisfactorily reproduced the principal features of the observed inlet duct and engine fact pressures. Four potentially adverse effects to engine operation from blast interaction were identified: blast-induced distortion, fan choking, afterburner blowout and shock-boundary layer induced distortion.

4875 (AD-A—066998) **Blast upgrading of existing structures. Final report Aug 77-Jan 79.** Gabrielsen, B.L.; Cuzner, G.; Lindskog, R. (Scientific Service, Inc., Redwood City, CA (USA)). Jan 1979. Contract DCPA01-77-C-0205. 279p. NTIS PC A13/MF A01.

A major facet of preparedness is the upgrading of structures to provide shelter from nuclear weapons effects. This report describes some upgrading concepts, develops practical techniques for predicting structural failure, and verifies the failure prediction methodology by comparing the analysis with structural failure test data developed under this program and available in the literature. The analyses and prediction techniques were applied to wood, steel, and concrete roof and floor specimens; and to static, dynamic, and combined loadings. The prediction methodology is founded on engineering mechanics, limit theory, and a statistical approach to failure analysis that enables realistic assessment to be made of failure probabilities based on the combined effects of statistical variation in materials, structural elements, and construction processes. The failure prediction methodology is demonstrated experimentally for wood and reinforced concrete floor structures. Because wood systems are the most technically demanding, the wood structure examples are analyzed in 'cookbook' style, with the source data reproduced in tables, and the governing probability distribution functions developed in detail for each of the various elements. The impact of significant changes in design procedures, steel grading and properties, and building codes over the years are discussed.

WEAPONRY

4876 (AD-A—062142) **Afwl technical objective number 1. Nuclear weapons technology. AFWL technical objective number 3. Advanced weapons technology. Fiscal year 1980. Technical report.** Collier, W.D. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Dec 1978. 31p. NTIS PC A03/MF A01.

Present DOD/USAF strategic planning is based on the ability of strategic weapon systems to survive and operate through an attack employing nuclear weapons. The energy from the detonation of a nuclear device takes many forms (EMP, X-ray, gamma ray,

thermal, blast, etc.) and is of sufficient amplitude and energy to seriously degrade or negate the systems under attack. As the design and interdependence of advanced systems become more intricate and the potential attacking force achieves greater numbers and sophistication, survival requirements become greater for those systems. Definition of the environment must be determined and improved as the postulated threat is revised or refined. Analysis and simulation techniques must be devised to be used in testing and assessing the survivability/vulnerability of Air Force systems. Every US Air Force aircraft and missile system with a nuclear capability must be conceived, developed, built, and operated in accordance with nuclear safety standards and have characteristics that are compatible with design, safety, and operational requirements of the Air Force. Advanced nuclear and nonconventional weapon research and technology development must continue to identify those technologies that will provide improved tactical and strategic offensive and defensive warfare capabilities.

4877 (SAND—79-8260) **SIXDOF: a computer program for trajectory simulation of ballistic flight vehicles.** Everett, R.N. (Sandia Labs., Livermore, CA (USA)). Oct 1979. Contract EY-76-C-04-0789. 72p. Dep. NTIS, PC A04/MF A01.

The report presents the trajectory computer program, SIXDOF. The program has been in use at Sandia Laboratories, Livermore, for flight simulation of ballistic flight vehicles and has served as an important design tool. The report includes a presentation of the prominent features of the mathematical model which describes the vehicle aero- and flight dynamics. Additionally, detailed descriptions of the program input and output are provided as a user's guide.

EXPLOSION DETECTION

4878 (AD-A—064200) **Special Data Collection System (SDCS) NTS Event 'Marsilly', 5 April 1977. Technical report.** Naylor, G.R.; Dawkins, M.S. (Teledyne Geotech, Alexandria, VA (USA)). 18 Dec 1978. Contract F08606-78-C-0007,. 9p. NTIS PC A02/MF A01.

This 'MARSILLY' event report contains seismic data from the Special Data Collection System (SDCS), and other sources for the above event. All SDCS stations were operational during this time period. RK-ON data were retrieved from the digital field tapes, and HN-ME data are from the analog back-up system. Both stations recorded positive short- and long-period signals.

4879 (AD-A—064285) **Special Data Collection System (SDCS) NTS Event 'Bulkhead', 27 April 1977. Technical report.** Naylor, G.R.; Dawkins, M.S. (Teledyne Geotech, Alexandria, VA (USA)). 18 Dec 1978. Contract F08606-78-C-0007,. 10p. NTIS PC A02/MF A01.

This event report contains seismic data from the Special Data Collection System (SDCS), and other sources for the 'Bulkhead' event. The report also contains epicenter information from seismic observations.

4880 (AD-A—064286) **Special Data Collection system (SDCS) NTS Event 'Crewline', 25 May 1977. Technical report.** Naylor, G.R.; Dawkins, M.S. (Teledyne Geotech, Alexandria, VA (USA)). 18 Dec 1978. Contract F08606-78-C-0007,. 8p. NTIS PC A02/MF A01.

This event report contains seismic data from the Special Data Collection System (SDCS), and other sources for the 'Crewline' event. The report also contains epicenter information from seismic observations.

4881 (AD-A—065319) **A study of amplitude variations and m sub b bias at lasa subarrays. Technical report.** Chang, A.C.; von Seggern, D.H. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 1 May 1978. Contract F08606-78-C-0007,. 71p. NTIS PC A04/MF A01.

LASA subarray amplitude anomalies are investigated using 395 medium-sized events, distributed in ten azimuthally divided sectors. Although LASA magnitudes, when averaged over all azimuths, are only slightly biased relative to NEIS magnitudes, the amount of bias varies with azimuth and subarray, suggesting that a simple station correction for m sub b bias is not adequate. In addition, fluctuations among LASA subarrays are about 0.15 in standard deviation, even when these magnitudes are calibrated in sectors. Details of such fluctuations are explained in part by local crustal and upper-mantle heterogeneities under LASA. The amplitude anomalies are linearly related to the amount of travel-time anomalies in each sector, implying that both effects are due to crustal focussing.

4882 (AD-A—065324) **Montana large aperture seismic array. Final technical report, 1 April-31 December 1978.** Matkins, R.E. (Ford Aerospace and Communications Corp., Billings, MT (USA). Engineering Services Div.). 25 Jan 1979. Contract F08606-78-C-0003. 38p. NTIS PC A03/MF A01.

The continued operation and maintenance activities at the Montana LASA during the period April 1 and June 30, 1978, and the seismic array roll-up activities between July 1 and December 31, 1978, are described. Array operations including the preparation of daily teleseismic event reports are detailed. Maintenance activities at both the data and maintenance centers are discussed. The array roll-up effort is described by task and the equipment disposition status reported.

4883 (AD-A—065487) **Special data collection systems (Project T/4703). Semiannual report, April-September 1978.** Sherwin, J.R.; Kraus, G.C. (Teledyne Geotech, Garland, TX (USA)). 29 Sep 1978. Contract F08606-78-C-0011,. 17p. NTIS PC A02/MF A01.

Work performed under Project T/4703, Special Data Collection Systems, is an extension of the program begun in 1973 under Contract F08606-74-C-0013. At the start of this period SDCS systems remained in operation at four sites. Two sites record short-period data on analog tape only; the Rio Blanco Colo., configuration is the same except that data are also recorded on the digital recorder. At the 4th site, both short-period and long-period data from a KS36000 system are recorded on analog and digital recorders. Operations at all sites continued until late August when all except Rio Blanco were closed. Equipment was returned for refurbishing and preparation for redeployment in October, 1978. A special project to collect high-frequency data at a site near McKinney, Texas, was begun in May. In the first phase, data were collected from both the KS36000 vertical and a standard vertical instrument in the high-frequency passband. These data are being analyzed to determine whether the KS36000 operates properly at this frequency. Phase two, which began in mid-September and will continue through December, will collect one channel of high-frequency data and three channels of intermediate period data from the KS36000 to determine the potential usefulness of such seismographs in detection of events at relatively close distances up to 650 km.

4884 (AD-A—066919) **Application of a combined source model for seismic discrimination. Technical report no. 21.** Hsiao, H.Y.A. (Texas Instruments, Inc., Dallas (USA)). 25 Oct 1978. Contract F08606-77-C-0004,. 102p. NTIS PC A06/MF A01.

The purpose of this study has been to use the observed long-period teleseismic surface wave data of earthquakes and presumed underground explosions to determine the source mechanisms and to use these source mechanism estimates to discriminate between the two classes of events. In order to demonstrate this purpose, fifteen events have been selected and analyzed for the Russian Eastern Kazakh (EKZ) region, central and northern Eurasia, and the United States Nevada Test Site (NTS). The observation stations available for this study included the Seismic Research Observatories (SRO), Abbreviated Seismic Research Observatories (ASRO), the High Gain Long-Period (HGLP) stations (the same as the previous VLPE), and existing VELANET arrays. For a fair comparison of explosion and earthquake events, both have been treated in the same way by using the combined source model which combines a point explosive source and a point double-couple source. In order to cut down computer expenses and widen the searching rangge of some parameters, a binary exhaustive search method was applied to modify the amplitude spectral fitting process without any constraint. The results obtained from this modified process gave very good spectral fits for most events and lowered the minimum residual fitting error of each event.

4885 (AD-A—067172) **Study of selected events in the Caucasus in a seismic discrimination context. Technical report.** Sobel, P.A.; von Seggern, D.H.; Sweetser, E.I.; Rivers, D.W. (Teledyne Geotech, Alexandria, VA (USA). Seismic Data Lab.). 7 Nov 1977. Contract F08606-78-C-0007,. 71p. NTIS PC A04/MF A01.

Eight earthquakes from the Caucasus occurring from 1971 to 1975 were examined in a seismic discrimination context. Seismograms from ALPA, LASA, NORSAR, and the HGLP and the WWSSN stations were studied for source mechanism, (M sub s - M sub b), corner frequency, pP, complexity, and spectral ratio. All the Caucasus events can be identified as earthquakes by means of pP and M sub s:M sub b when compared to Kazakh and southwest USSR explosions. However it seems plausible that these discriminants could be rendered ineffective for events in the Caucasus by means of a shot array.

4886 (AD-A—067368) **Earthquake characteristics and earthquake-explosion discrimination. Final report 1 May-31 October 78.** Archambeau, C.B.; Cormier, V.; Lundquist, G.; Stevens, J. (Cooperative Inst. for Research in Environmental Science, Boulder, CO (USA)). 1979. 3p. Availability: Microfiche copies Only.

No abstract available.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

4887 (NUREG/CR—0936) **Recommendations for meteorological measurement programs and atmospheric diffusion prediction methods for use at coastal nuclear reactor sites.** Raynor, G.S.; Michael, P.; SethuRaman, S. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 66p. (BNL-NUREG—51045). Dep. NTIS, PC A04/MF A01.

A study, based on a literature review, was performed to examine currently recommended meteorological measurement programs and diffusion prediction methods for nuclear power plants to determine their adequacy for plants located in coastal zones. Although procedures for handling the near worst case (stable, light wind situation) were judged adequately conservative, deficiencies in guidelines and procedures were found with respect to the following: failure to consider the role of coastal internal boundary layers, specifications for tower locations and instrument heights, methods of classifying atmospheric stability, methods of allowing credit for plume meander and models specified for diffusion calculations. Recommendations were made for changes in the guidelines applicable to these topics. Areas in which additional research is needed were identified.

4888 **Pollutant transfer across the cavity region behind a two-dimensional fence.** Sheih, C.M. (Argonne National Lab., IL); Mulhearn, P.J.; Bradley, E.F.; Finnigan, J.J. *Atmos. Environ.;* **12**: 2301-2307(1978).

The objectives of the present study are to construct a simple mathematical expression capable of predicting a pollutant flux across the cavity region or separation bubble behind a two-dimensional fence from knowledge of the fence height, the separation bubble length, the free-stream mean wind velocity, and the concentrations inside and outside the separation bubble. The separation bubble length is defined as the distance from the fence to the ground-level stagnation point where the mean wind direction changes from towards to away from the fence. In a practical application, the stagnation point can be determined easily by using cigarette smoke or a light-weight flag. An analytical expression for the pollutant flux has been obtained from the solution of the partial differential equations of momentum and pollutant transfer, using assumptions derived from experimental results. In order to determine the values of the constants in the analytical solution and to verify some of the assumptions, heat is used as a tracer representing the pollutant in wind-tunnel experiments conducted with various combinations of fence height, heat input, and free-stream mean wind velocity. The wind tunnel results also show that excess temperature profiles behind the fence are similar if the excess temperature is scaled by the product of a reference excess temperature and the heat input, the vertical coordinate is scaled by the fence height, and the downstream distance from the fence is scaled by the separation bubble length.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 3996, 4022, 4773, 4912, 4915, 4936, 4937, 5008, 5017, 5020

4889 (AD-A—062082) **Analysis of aerosols and fallout from high-explosive dust clouds. Volume II. Final report 3 May 71-30 September 73.** Green, W.D.; Fegley, M.J. (Meteorology Research, Inc., Altadena, CA (USA)). 3 Mar 1977. Contracts DASA01-71-C-0154;DNA001-73-C-0040. 228p. NTIS PC A11/MF A01.

Dust clouds from seven high-explosive detonations ranging from 20 to 500 tons in the Middle Gust-Mixed Company series were sampled, using various aircraft-mounted instruments. A wet cyclone system proved to be the best device for sampling airborne dust. Dust concentrations as a function of time and location in the clouds were determined. One cloud was underflown as early as Z + 1:22, and another was entered at Z + 1:36. Fallout was measured on three tests, and various experiments were conducted to detect sweepup of dust from outside the crater zone. Gas samples were collected and analyzed from inside the 500-ton Mixed Company III cloud. Selected airborne dust and fallout samples were sized using an optical image processing computer. Density measurements were made to determine if particles expanded or melted in the fireball. Volume II contains ten appendices which include the following topics: Aircraft Instrumentation; Collection Efficiency Tests -- Wet cyclone vs filter sampler; Ground Experiments and Installations; Laboratory Analysis of Data; Size Distribution Data -- Airborne dust samples and Fallout dust samples; Particle Density Data--Airborne and fallout samples; Mixed Company III--Environmental impact data; Ground operations summary; and Sieve Analysis of Fallout Samples.

4890 (AD-A—062452) **SWIR-MWIR electron fluorescence measurements in N2/O2 and air. Environmental research papers.** Green, B.D.; Caledonia, G.E.; Murphy, R.E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 4 Apr 1978. 31p. NTIS PC A03/MF A01.

The infrared fluorescence of electron irradiated room air and mixtures of N2/O2 has been observed over the spectral range of 1600-6700/cm. Dominant spectral features include the NO fundamental and first overtone bands as well as the CO2(nu3) and N2O(nu3) fundamental bands. Comparisons between the spectra observed in room air and laboratory N2/O2 mixtures are provided. (Author)

4891 (AD-A—064905) **Concorde air sampling program. Intercalibrations and collaborative measurements. Final report April-September 1978.** Rasmussen, R.A. (Oregon Graduate Center, Beaverton (USA)). 26 Sep 1978. Contract W1-78-3745-1. 31p. NTIS PC A03/MF A01.

Joint analyses of air samples similar to the operational type of samples obtained on Concorde flights were accomplished at A.E.R.E. Harwell in July 1978 between the Oregon Graduate Center and the Division of Environmental and Medical Sciences, Harwell. The studies were preliminary to directly comparing the data previously obtained by the contractor on the same species during an extensive series of high altitude flights made in 1975-1977. The interlaboratory calibrations and comparisons were successful. A second round of sample exchanges are in progress. Separately the joint studies measured for the first time the concentration of CF4 in the ambient atmosphere as well as the related trace gases COS and CS2 in several samples of volcanic emissions. The report includes a discussion of the Concorde program as to air sampling capabilities, operation, sampling schedule and the uniqueness of related opportunities of the Concorde Air Sampling Program.

4892 (AD-A—065472) **Status of representative two-dimensional models of the stratosphere and troposphere as of mid-1978. Interim report, 15 April 1977-15 October 1978.** Hidalgo, H. (Institute for Defense Analyses, Arlington, VA (USA)). Oct 1978. Contract DOT-FA-77WA-3965. 164p. NTIS PC A08/MF A01.

This paper reviews ongoing efforts aimed at solution of basic problems dealing with ozone chemistry and atmospheric mass transports in representative two-dimensional (altitude and latitude) photochemical models of the troposphere and stratosphere. Emphasis is placed on the impact of recent measurements of the reaction rate coefficients for the reactions HO2 + NO yields OH + NO2 and HO2 + 03 yields OH + 2 02 on: (a) the balance between ozone production and destruction on both ozone concentrations and columns at middle northern latitudes during summer for an oxygen-hydrogen-nitrogen atmosphere; (b) calculation of NO sub x concentrations in the upper troposphere which are important for the effects of high-altitude subsonic flight on the ozone column; and (c) estimates of the tropospheric NO sub x and OH concentrations as well as the removal rates of water-soluble species in the lower troposphere from considerations of the tropospheric ozone and carbon monoxide budgets. The severe limitations of arbitrary extensions of available 2-D parameterizations of the dynamics to an upper troposphere and lower stratosphere assumed to be perturbed by large emissions of engine effluents are brought out from numerical solutions of the primitive equations for instantaneous and continuous sources of inert material in the lower stratosphere. The paper includes preliminary 2-D results based on the revised ozone chemistry for the trend of subsonic and supersonic flight effects ozone.

4893 (AD-A—067242) **Development of criteria for monitoring of airport ground pollution. Volume I. Study. Final report Sep 75-Jul 77.** Ludwig, C.B.; Yoder, J.R. (Science Applications, Inc., La Jolla, CA (USA)). Nov 1978. Contract DOT-FA76WA-3725. 438p. NTIS PC A19/MF A01.

Criteria are developed by which the validity of pollution predictions and measurements in the airport environs can be judged. The criteria are applied to three technologies: (1) predictive mathematical models, (2) measurements by point samplers, and (3) measurements by remote monitors. For mathematical models the criterion is the agreement between predicted and measured pollution levels. Various mathematical models are described, analyzed and ranked by weighted attributes as screening models and as validation models. For point samplers, the criteria have been developed based on EPA-approved measurement principles and procedures for testing performance characteristics and for determining a consistent relationship to reference methods. Remote monitors belong to an evolving technology that has not yet been approved as to measurement principles. Thus criteria are developed to select certain remote sensing systems as potential candidates for air enforcement monitors. Data validation procedures are developed for the selected remote monitors. (Author)

4894 (AD-A—067243) **Development of criteria for monitoring of airport ground pollution. Volume II. Data validation procedures. Final report Sep 75-Jul 77.** Ludwig, C.B.; Yoder, J.R. (Science

Applications, Inc., La Jolla, CA (USA)). Nov 1978. Contract DOT-FA76WA-3725. 337p. NTIS PC A15/MF A01.

Criteria are developed by which the validity of pollution predictions and measurements in the airport environs can be judged. The criteria are applied to three technologies: (1) predictive mathematical models, (2) measurements by point samplers, and (3) measurements by remote monitors. For mathematical models the criterion is the agreement between predicted and measured pollution levels. Various mathematical models are described, analyzed and ranked by weighted attributes as screening models and as validation models. For point samplers, the criteria have been developed based on EPA-approved measurement principles and procedures for testing performance characteristics and for determining a consistent relationship to reference methods. Remote monitors belong to an evolving technology that has not yet been approved as to measurement principles. Thus criteria are developed to select certain remote sensing systems as potential candidates for air enforcement monitors. Data validation procedures are developed for the selected remote monitors.

4895 (AD-A—067262) **Aircraft air pollution emission estimation techniques - ACEE. Final report Aug 77-Aug 78.** Scott, H.A. Jr; Naugle, D.F. (Civil and Environmental Engineering Development Office, Tyndall AFB, FL (USA). Detachment 1 (ADTC)). 1 Sep 1978. 107p. Availability: Microfiche copies only.

A five-step analytical methodology is presented that can be adapted to nearly any aircraft related air quality assessment problem. The methodology is for use by base level environmental personnel to calculate: (1) annual aircraft emissions, and (2) downfield pollutant concentrations. The latest individual engine emission factors and other information required for the methodology are contained in this report. (Author)

4896 (COO—4448-2) **Intracavity absorber effects in a CW dye laser. Progress report, June 1, 1978-May 31, 1979.** Brink, G.O. (State Univ. of New York, Buffalo (USA). Dept. of Physics and Astronomy). Feb 1979. Contract EG-77-S-02-4448. 8p. Dep. NTIS, PC A02/MF A01.

The technique of dye laser intercavity absorption is being studied as a possible method of detecting small densities of atoms and molecules in combustion systems. Two types of phenomena are observed. Absorption signals, which, although of complex line shape, result in a decrease in laser intensity at the absorption wavelength are observed over a wide range of absorber densities. At values of the pump laser power above a certain threshold an enhancement effect is observed in which the dye laser spectrally condenses at the absorber wavelength. The enhancement effect allows the detection of very low densities of sodium with good signal to noise ratio. The data obtained to date are discussed.

4897 (IVL-B—473) **Data for the effect of particles in the gases on environment.** Steen, B. (Swedish Water and Air Pollution Research Lab., Goeteborg). Nov 1978. 15p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Calculations are made of the effect of particles in flue gases locally and regionally on transmission of light in the atmosphere, formation of condensation nuclei, chemical composition of the ground, and health of the people.

4898 (IVL-B—504) **Interaction of gases with sulphuric acid aerosol in the atmosphere.** Lee, Y.H.; Brosset, C. (Swedish Water and Air Pollution Research Lab., Goeteborg). Jul 1979. 15p. (CONF-791065—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From WMO symposium on the long-range transport of pollutants and its relation to general circulation including stratospheric/tropospheric exchange processes; Sofia, Bulgaria (1 Oct 1979).

Partial pressure of ammonia was calculated for a number of points in the phase diagram H_2SO_4-H_2O-NH_3. It was found that the pairs of values PNH_3 and relative humidity determine if the system will be present as solid phases or as solution. In addition, the partial pressures for HNO_3 and HCl were calculated in the system H_2SO_4-H_2O-NH_3-HNO_3-HCl in which the concentration of NO_3^- and Cl^- was small in relation to H_2SO_4. These calculations showed that a nitrate concentration amounting to 0.1 of the total sulphate concentration could be present in the system only if the acid was neutralized to 90 to 95%. The results can be utilized to predict, by means of measurements of gaseous components in air, the equilibrium composition of a sulphuric acid aerosol.

4899 (NTIS/PS—79/0064) **Detection and sampling in flue gases. Volume 1. 1964-1977 (citations from the NTIS data base). Report for 1964-1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 255p. NTIS PC N01/MF N01.

This bibliography covers the detection and sampling of combustion product flue gases within the stack and at the stack exit. The citations pertain to detector design along with the detection techniques for various pollutants, including NOx, SO2, CO, and particles. (This updated bibliography contains 249 abstracts, none of which are new entries to the previous edition.)

4900 (NTIS/PS—79/0065) **Detection and sampling in flue gases. Volume 2. 1978-February, 1979 (citations from the NTIS data base). Report 1964-February 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 90p. NTIS PC N01/MF N01.

Reports are cited which discuss the detection and sampling of combustion product flue gases within the stack and at the stack exit. Detector design is covered, along with detection techniques for various pollutants, including NOx, SO2, CO, and particulates. (This updated bibliography contains 84 abstracts, 70 of which are new entries to the previous edition.)

4901 (NTIS/PS—79/0281) **Financing and taxation for urban control of pollution (a bibliography with abstracts). Report for 1964-March 1978.** Jones, J.E. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 228p. NTIS PC N01/MF N01.

The citations relate to urban and regional planners who wish to study means of financing pollution abatement programs and of taxing sources as a means of pollution reduction. The reports are divided into three sections: Air pollution studies, solid waste disposal studies, and water pollution and sewage treatment studies.

4902 (NTIS/PS—79/0580) **Air pollution emission factors (a bibliography with abstracts). Report for 1964-May 79.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 200p. NTIS PC N01/MF N01.

Emission factors for various industry, stationary, and mobile sources are presented in this annotated bibliography of research reports. The calculation and use of these factors are included. (This updated bibliography contains 193 abstracts, 61 of which are new entries to the previous edition.)

4903 (PB—290107) **Investigations of nitrogen oxides within the plume of an isolated city. Final report.** Spicer, C.W.; Joseph, D.W.; Ward, G.F. (Battelle Columbus Labs., OH (USA)). 21 Jul 1978. 140p. NTIS PC A07/MF A01.

The study described in this report was designed to validate and extend the earlier Battelle field investigations of NOx reactions in a different locale and with improved analytical methods. The program focused principally on determining the rate of NOx transformation within a reacting urban plume. An instrumented twin-engine research aircraft was employed for continuous monitoring and sample collection within and downwind of Phoenix, Arizona. Both gas and aerosol samplers were collected. The variables measured during aircraft operations included O3, NOx, HONO2, PAN, CO, F-11, C2H2, THC, CH4, NO3(-), SO4(-2), temperature and relative humidity. A ground station measured these and a number of other variables. (Color illustrations reproduced in black and white)

4904 (PB—290999) **Indoor air pollution in the residential environment. Volume I. Data collection, analysis and interpretation. Final report.** Moschandreas, D.J.; Stark, J.W.C.; McFadden, J.E.; Morse, S.S. (Geomet, Inc., Gaithersburg, MD (USA)). Dec 1978. Contract EPA-68-02-2294. 204p. NTIS PC A10/MF A01.

A 24-month study was undertaken to characterize the indoor residential air quality. Seventeen residential dwellings were monitored, each for a 14-day period. Air samples were collected from four locations: one outdoor site adjacent to the building; and three indoor sites, the kitchen, bedroom, and living room. 'Continuous' sampling was carried out for CO, SO2, NO, NO2, CO2, O3, CH4, and THC. TSP, RSP, SO_4, NO_3, Pb, ammonia, and aldehydes were monitored intermittently. Aerosol samples were collected for elemental analysis by the Proton Induced X-ray Emission (PIXE) technique. In addition, data on energy parameters, infiltration rates, and family activities were obtained by observations, field experiments, and daily questionnaires, respectively. Each residence was monitored with minimal interference in the daily activities of the occupants; thus, the residential pollutant concentrations were determined under real-life conditions. Finally, the relationship between energy conservation measures and air quality in the indoor environment is examined. The observed indoor air pollutant concentrations were, on the average, not very high; however, persistent moderate and, at times, elevated pollutant levels were observed. The lack of studies concerning the health implications of such levels is briefly discussed.

4905 (PB—291000) **Indoor air pollution in the residential environment. Volume II. Field monitoring protocol, indoor episodic pollutant release experiments and numerical analyses. Final report.** Moschandreas, D.J. (Geomet, Inc., Gaithersburg, MD (USA)). Dec 1978. Contract EPA-68-02-2294. 244p. NTIS PC A11/MF A01.

This second volume of the two-volume series on 'Indoor Air Pollution in the Residential Environment' contains three chapters. Chapter 1 describes the experimental monitoring design for obtaining continuous and intermittent air samples under 'real-life' conditions. The site selection criteria, monitoring techniques, data man-

agement system and quality assurance program are discussed in detail. Chapter 2 refers to specific experiments of episodic contaminant release in the indoor residential environment. The monitoring technique, developed by IITRI, and the data obtained are presented in this section. Finally, in Chapter 3 numerical techniques used to determine the sensitivity coeffients of the GEOMET Indoor-outdoor Air Pollution (GIOAP) model, see Volume I, are detailed.

4906 (PB—292520) **Air pollutant emission factors for military and civil aircraft. Final report, August 1977-April 1978.** Sears, D.R. (Lockheed Missiles and Space Co., Huntsville, AL (USA)). Oct 1978. Contract EPA-68-02-2614. 91p. NTIS PC A05/MF A01.

Using data supplied by the U.S. Navy, U.S. Air Force, USEPA Office of Mobile Source Air Pollution Control, as well as published information, tables of military aircraft fuel characteristics, aircraft classifications, military and civil times in mode, engine modal emission rates, and aircraft emission factors per landing-takeoff cycle are calculated and compiled. The data encompass 59 engines and 89 aircraft. Additional discussion includes information related to benzo(a)pyrene emissions and to hydrocarbon emissions (volatile organic) with potential to produce photochemical oxidant.

4907 (PB—295485) **Emission of sulfur-bearing compounds from motor vehicle and aircraft engines. A report to congress.** Kawecki, J.M. (Biospherics Inc., Rockville, MD (USA)). Aug 1978. Contract EPA-68-02-2926. 455p. NTIS PC A20/MF A01.

This report was generated in response to section 403(g) of The Clean Air Act as amended August, 1977. The report covers (1) a review of emission factors for H_2SO_4, SO_2, sulfate, H_2S, and carbonyl sulfide from motor vehicles, motor vehicle engines and aircraft engines; (2) a review of the known effects on health and welfare of these compounds; (3) the status on technology to control such emissions; and (4) an analysis of the costs of control weighed against the social benefits of such control. Available emission factors for these pollutants were converted to ambient air concentrations by using dispersion and stochastic models. The predicted ambient air concentrations were compared to concentrations of these pollutants known to cause adverse health or welfare effects. Results of this comparison suggest that benefits of any control are likely to be small. Except for 3-way catalytic control technology, cost data for fuel desulfurization and vehicle on-board control technology suggest an extremely large economic impact. Consequently, specific controls of sulfur-bearing compounds from mobile sources are not recommended.

4908 (PB—295912) **Plan for air pollution research in the Texas Gulf Coast Area. Volume I. Plan for air quality studies. Final report.** Tannahill, G.; Lambeth, B.; Balfour, D.; Jones, D.; Stuart, J. (Radian Corp., Austin, TX (USA)). Apr 1979. Contract EPA-68-02-2955. 96p. NTIS PC A05/MF A01.

In response to Congressional mandates, the U. S. Environmental Protection Agency will conduct an extensive study of air pollution related problems in the Texas Gulf Coast Area. As an initial effort, EPA awarded a contract to review the existing technical information and record the local viewpoint on air pollution problems in the area, define research needs, and design experimental studies addressed to these needs. Results are presented in 5 volumes. Volume I describes and discusses a research plan for air quality studies.

4909 (PB—295914) **Plan for air pollution research in the Texas Gulf Coast Area. Volume III. summary of previous air quality studies and data. Final report.** Lambeth, B.W.; Maxey, B.J.; Stadig, W.P. (Radian Corp., Austin, TX (USA)). Apr 1979. Contract EPA-68-02-2955. 303p. NTIS PC A14/MF A01.

This document contains a summary of all available air pollution related information concerning air pollution - emissions, measurements, and meteorology - for the Texas Gulf Coast Area (Houston area). Included is a summary of major reports and studies covering air quality in the Houston area, with conclusions and recommendations, as well as air pollution emissions data summaries, air quality monitoring site information, air quality data summaries, and additional meteorological information. Finally, a bibliography with abstracts is provided for the topics of emissions, monitoring, meteorology, and control, which are relevant to the Texas Gulf Coast Study.

4910 **Analysis of diffusion battery data.** Soderholm, S.C. (Univ. of Rochester, NY). *J. Aerosol Sci.;* **10**: 163-175(1979).

A brief review is given of the use of diffusion batteries to obtain size information about ultrafine aerosol particles. Accurate formulas are included for the penetration functions of circular tube and parallel plate diffusion cells. After noting the usefulness of some previously suggested data inversion techniques, a new method for obtaining a complete solution is outlined. The techniques are illustrated by the analysis of some experimental data.

4911 **Potentially carcinogenic species emitted to the atmosphere by fossil-fueled power plants.** Natusch, D.F.S. (Colorado State Univ., Fort Collins). *Environ. Health Perspect.;* **22**: 79-90(Feb 1978).

The identities and physicochemical characteristics of potentially carcinogenic species emitted to the atmosphere by fossil-fueled power plants are presented and discussed. It is pointed out that many so-called carcinogens are preferentially concentrated on the surface of respirable fly ash particles thus enabling them to come into intimate contact with lung tissues when inhaled. Relatively little information is available about the identities of particulate polycyclic organic compounds whose emission from coal-fired power plants may well be substantially greater than hitherto supposed. The importance of chemical changes, which several species may undergo following emission (but prior to inhalation) in determining their potential carcinogenic impact, is stressed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 4889

4912 (BNL—51031) **1978 environmental monitoring report.** Naidu, J.R. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 100p. Dep. NTIS, PC A05/MF A01.

The environmental levels of radioactivity and other pollutants found in the vicinity of Brookhaven National Laboratory (BNL) during 1978 are summarized. As an aid in the interpretation of the data, the amounts of radioactivity and other pollutants released in airborne and liquid effluents from Laboratory facilities to the environment are also indicated. The environmental data includes external radiation levels; radioactive air particulates; tritium and iodine concentrations; the amounts and concentrations of radioactivity in and the water quality of the stream into which liquid effluents are released; the concentrations of radioactivity in sediments and biota from the stream; the concentrations of radioactivity in and the water quality of ground waters underlying the Laboratory; and concentrations of radioactivity in milk samples obtained in the vicinity of the Laboratory.

4913 (NUREG/CR—1133) **Radon and radon-daughter concentrations in air in the vicinity of the Anaconda Uranium Mill.** Momeni, M.H.; Lindstrom, J.B.; Dungey, C.E.; Kisieleski, W.E. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 97p. (ANL/ES—81). Dep. NTIS, PC A05/MF A01.

Radon concentration, working level, and meteorological variables were measured continuously from June 1977 through June 1978 at three stations in the vicinity of the Anaconda Uranium Mill with measurements integrated to hourly intervals. Both radon and daughters show strong variations associated with low wind velocities and stable atmospheric conditions, and diurnal variations associated with thermal inversions. Average radon concentration shows seasonal dependence with highest concentrations observed during fall and winter. Comparison of radon concentrations and working levels between three stations shows strong dependence on wind direction and velocity. Radon concentrations and working-level distributions for each month and each station were analyzed. The average maximum, minimum, and modal concentration and working levels were estimated with observed frequencies. The highest concentration is 11,000 pCi/m^3 on the tailings. Working-level variations parallel radon variations but lag by less than one hour. The highest working levels were observed at night when conditions of higher secular radioactive equilibrium for radon daughters exist. Background radon concentration was measured at two stations, each located about 25 km from the mill, and the average is 408 pCi/m^3. Average working-level background is 3.6×10^{-3}.

4914 (NUREG/CR—1133(App.)) **Appendix to radon and radon-daughter concentrations in air in the vicinity of the Anaconda Uranium Mill.** Momeni, M.H.; Lindstrom, J.B.; Dungey, C.E.; Kisieleski, W.E. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 86p. (ANL/ES—81(App.)). Dep. NTIS, PC A05/MF A01.

Information is presented on the following subjects: site characteristics - stratigraphic description and water-bearing characteristics; meteorology - pooled observations made at two stations of windspeed, wind direction, and stability class; radon concentrations in air at various stations; and, frequencies of occurrence of given working levels at various stations. (JGB)

REGULATIONS

REFER ALSO TO CITATION(S) 4699

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 4019, 4919, 4920

4915 (DOE/TIC—10293) **Modeling the circulation of carbon in the world's terrestrial ecosystems.** Emanuel, W.R.; Killough, G.G.; Olson, J.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 40p. Dep. NTIS, PC A03/MF A01.

A mathematical model for the circulation of carbon in the world terrestrial ecosystems is proposed. A five-compartment representation is developed which corresponds to the functional components studied by field ecologists. Rate coefficients for this linear dynamic model are calculated from estimates of the 1970 standing crops and compartment exchanges of carbon. The model is analyzed in terms of response to a unit impulse, thereby displaying a transient time distribution. The response to a hypothetical pulse input through gross primary production is also simulated, illustrating the efficiency of the terrestrial carbon system in transferring carbon into longer storage components. Finally, the concept of CO_2 fertilization is examined by allowing gross primary production to increase in response to higher atmospheric concentrations. Although the standing crop of carbon in photosynthesizing compartments is induced to grow from a hypothetical preindustrial level to a specified 1970 level, the accompanying increase in other compartments is not as large as obtained in earlier model formulations which incorporate an input from the atmosphere directly to compartments containing carbon in woody material or soil.

4916 **Effects of nitrogen and phosphorus additions on deciduous litter decomposition.** Kelly, J.M. (Tennessee Valley Authority, Muscle Shoals, AL); Henderson, G.S. *Soil Sci. Soc. Am. J.;* **42**: No. 6, 972-976(Nov 1978).

Urea and concentrated superphosphate were applied to plots in a deciduous forest to examine their effects on decomposition of white oak leaves (Quercus alba L.) in litter bags and the associated populations of decomposer organisms. Urea applications decreased soil invertebrate populations by about 30% and caused a three- to four-fold increase in bacterial populations while increasing decomposition rates by 1 and 3% at the 550 and 1100 kg/ha N levels, respectively. Superphosphate additions caused bacterial populations to decrease by 30% at the highest addition rate and decreased decomposition by 4 and 6% at the 275 and 550 kg/ha P rates, respectively. Soil acidity changes following fertilizer additions appear to be primarily responsible for observed results although longer-term changes in decomposition may be associated with changes in the nutrient status of the forest floor.

4917 **Potassium and rubidium adsorption and diffusion in soil.** Baligar, V.C.; Barber, S.A. (Purdue Univ., West Lafayette, IN). Contract AT(11-1)-1495. *Soil Sci. Soc. Am. J.;* **42**: No. 2, 251-254(Mar 1978).

Uptake of cations by plant roots growing in soil is believed to be influenced by the relative adsorption strengths of cations by soil exchange sites. The adsorption of K and Rb by four soils was investigated to determine the differences in adsorption of K and Rb which may occur and how they are affected by soil properties with the view of using this information to evaluate the uptake mechanisms for K and Rb by plant roots growing in soil. Rubidium was adsorbed preferentially to K by all four soils. Selectivity coefficient k/sub Rb/K/, indicating the size of the effect ranged from 1.9 to 4.4. Adding K decreased k/sub Rb/K/, increased the amount of nonexchangeable Rb, and decreased exchangeable Rb. There was a negative correlation ($r^2 = 0.78$) between exchangeable K in the soil and k/sub Rb/K/. The level of K in the soil had a greater effect on k/sub Rb/K/ than varying types of exchange sites present due to differences in clay and amounts of organic matter in the four soils investigated. The size of the selectivity coefficient indicated that the difference between K/Rb ratios in the solution and exchange phases of these soils used and differences between soils made them suitable for use in plant uptake studies of the mechanisms of K and Rb uptake.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 4901, 4915, 4937, 5007

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 4913, 4914

SOIL

REFER ALSO TO CITATION(S) 4776

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 4917

4918 (LA-UR—79-2807) **Experiments involving 238-Plutonium dioxide and the environment.** Steinkruger, F.J.; Nelson, G.B.; Patterson, J.H.; Matlack, G.M.; Waterbury, G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-791049—18). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

The interactions of $^{238}PuO_2$ with terrestrial and aquatic environments have been examined. Samples were removed periodically and analyzed for plutonium to determine dispersion. The samples from terrestrial experiments were acidified, reduced in volume, and analyzed by liquid scintillation counting while aquatic experiment samples were diluted and counted by liquid scintillation. Results from the aquatic experiments indicated that the release rate was independent of the thermal power of the source. More plutonium was released in cold fresh water systems than in warm or cold seawater. Plutonium migration through soils appeared to be independent of soil type. Seasonal variations in plutonium migration appeared to result from the different quantity of water passing through the soil. Large pieces of source material released more plutonium to the environment which may be a thermal spallation effect. A simulated tidal experiment in which the source cycled into and out of the seawater twice a day resulted in severe fracturing of the source.

4919 **Potassium uptake by onion roots characterized by potassium/rubidium ratio.** Baligar, V.C.; Barber, S.A. (Purdue Univ., West Lafayette, IN). Contract AT(11-1)-1495. *Soil Sci. Soc. Am. J.;* **42**: No. 4, 618-622(Jul 1978).

A common belief is that plant roots absorb cations from the solution phase of the soil. Experiments with corn (Zea mays L.) using K/Rb ratio to evaluate the source of K and Rb absorbed indicated the plant roots absorbed these ions in the ratio of exchangeable K and Rb. The objective of this research was to study the source of K and Rb absorbed from soil by onion (Allium cepa) roots since they do not have root hairs and this may influence the uptake mechanism. Onions absorbed K/Rb with a ratio which was intermediate between the ratio of exchangeable K and Rb and the ratio of these cations in solution. In comparison with corn, onions absorbed K at one-third the rate, but absorbed water three times faster so that mass flow contributed a greater proportion of K absorbed by onions than that by corn. This, rather than differences in root hairs may be the reason for the observed differences in K uptake between corn and onions.

4920 **Use of K/Rb ratio to characterize potassium uptake by plant roots growing in soil.** Baligar, V.C.; Barber, S.A. (Purdue Univ., West Lafayette, IN). Contract AT(11-1)-1495. *Soil Sci. Soc. Am. J.;* **42**: No. 4, 575-579(Jul 1978).

Interaction between the plant root and the soil on cation influx into the root is not well understood. Use of the ratio of K/Rb, two ions absorbed interchangeably by the root, enables measurement of the K ion medium influencing K flux into the root. In experiments with corn (Zea mays L.) grown in eight soil-K systems in a growth chamber, the K/Rb ratio of uptake was similar to the K/Rb ratio of the ions on the exchange sites, and not the K/Rb ratio of the solution cations. The data may be interpreted to indicate that K and Rb on the exchange sites had more influence on K and Rb flux into the root than K and Rb in solution. Diffusion of K and Rb from the soil to H-saturated exchange membranes was in the ratio of K/Rb in solution.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 4887, 4988

4921 (EMSL-LV—0539-27) **Summer trapping method for mule deer.** Giles, K.R. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Jul 1979. Contract EY-76-A-08-0539. 7p. Dep. NTIS, PC A02/MF A01.

A summer mule deer trapping method which uses modified Clover traps in a circular corral with water as a bait is described. Drug restraint was used to facilitate safe handling of mule deer by the investigator. Fifteen mule deer were safely captured and outfitted with radio transmitters, ear tags, and reflective markers, and their movements monitored to determine migration patterns.

4922 (UCRL—15078) **Seismic risk analysis for the Babcock and Wilcox facility, Leechburg, Pennsylvania.** (TERA Corp., Berke-

ley, CA (USA)). 21 Oct 1977. Contract W-7405-ENG=48. 46p. Dep. NTIS, PC A03/MF A01.

The results of a detailed seismic risk analysis of the Babcock and Wilcox Plutonium Fuel Fabrication facility at Leechburg, Pennsylvania are presented. This report focuses on earthquakes; the other natural hazards, being addressed in separate reports, are severe weather (strong winds and tornados) and floods. The calculational method used is based on Cornell's work (1968); it has been previously applied to safety evaluations of major projects. The historical seismic record was established after a review of available literature, consultation with operators of local seismic arrays and examination of appropriate seismic data bases. Because of the aseismicity of the region around the site, an analysis different from the conventional closest approach in a tectonic province was adapted. Earthquakes as far from the site as 1,000 km were included, as were the possibility of earthquakes at the site. In addition, various uncertainties in the input were explicitly considered in the analysis. The results of the risk analysis, which include a Bayesian estimate of the uncertainties, are presented, expressed as return period accelerations. The best estimate curve indicates that the Babcock and Wilcox facility will experience 0.05 g every 220 years and 0.10 g every 1400 years. The bounding curves roughly represent the one standard deviation confidence limits about the best estimate, reflecting the uncertainty in certain of the input. Detailed examination of the results show that the accelerations are very insensitive to the details of the source region geometries or the historical earthquake statistics in each region and that each of the source regions contributes almost equally to the cumulative risk at the site. If required for structural analysis, acceleration response spectra for the site can be constructed by scaling the mean response spectrum for alluvium in WASH 1255 by these peak accelerations.

4923 Long-distance movements of Arctic Foxes tagged in northern Alaska. Eberhardt, L.E.; Hanson, W.C. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Can. Field Nat.;* **92**: No. 4, 386-389(1978).

A total of 193 Arctic Foxes (Alopex lagopus) have been eartagged in northern Alaska since March 1975. Eighteen tagged foxes have been recovered since their release; seven involved long-distance movements ranging from 129 to 945 km, some of which were apparently made irrespective of local food availability. Maximum average travel rate during long-distance movements was 24 km/d.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 5010

4924 Primary productivity of emergent macrophytes in a Wisconsin freshwater marsh ecosystem. Klopatek, J.M.; Stearns, F.W. (Wisconsin Univ., Milwaukee). *Am. Midl. Nat.;* **100**: No. 2, 320-332(Oct 1978).

In 1972 primary production of various emergent macrophytes was examined in Theresa Marsh, a shallow, semimanaged impoundment in southeastern Wisconsin. Dominant macrophytes included Typha latifolia, Scirpus fluviatilis, Carex lacustris, Phalaris arundinacea and a shrub, Salix interior. Seasonal patterns of production as well as total production varied greatly among species. With estimates for litter loss and belowground production, annual net primary production ranged from 1181 g/m^2/year for Carex lacustrris to nearly 3200 g/m^2/year for Typha latifolia. Peak standing crop values were generally among the highest reported. Average productivities during the growing season, however, were relatively low, ranging from 6.31 to 10.52 g/m^2/day for aboveground standing crops. Primary production was also estimated for transient species that occurred on mud flats following a marsh drawdown. The high primary production within the marsh appears to be based on high nutrient levels as indicated by the marsh water and soil chemistry.

4925 Production biology of Eurasian watermilfoil (Myriophyllum spicatum L.): A review. Grace, J.B.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). *J. Aquat. Plant Manage.;* **16**: 1-11(1978).

The purpose of this paper is to review the existing information on physiological aspects that relate to the productivity of Eurasian watermilfoil. Interest in the production biology of this species is manifold: (1) A better understanding of the processes involved in growth and the factors which control these processes may lead to more effective control methods. Many of the problems created by Eurasian watermilfoil result from its abundance rather than simply its presence, and invasions of Eurasian watermilfoil do not always lead to major infestations. (2) Knowledge of the factors controlling productivity may improve our ability to anticipate future problems. (3) The productivity of Eurasian watermilfoil is central to its competitive capabilities since light is often limiting in aquatic environments, and large plants or dense stands are likely to have a competitive advantage over smaller species for light. Also, since dispersion is principally by fragmentation, the number of disseminules increases as more biomass is produced. (4) Since Eurasian watermilfoil is currently a major component of the littoral zone of many lakes and reservoirs, it is of some limnological significance, particularly with regard to energy flow and nutrient cycling.

4926 Density-dependent function for fishing mortality rate and a method for determining elements of a Leslie matrix with density-dependent parameters. Van Winkle, W. (Oak Ridge National Lab., TN). *Trans. Am. Fish. Soc.;* **107**: No. No. 3, 395-401(1978).

A density-dependent function for the instantaneous fishing mortality rate is presented. It is shown that this function may be readily incorporated into the age-specific probability of survival in a Leslie-matrix population model. A method is presented for indirectly determining the probability of survival for age-class O of a fish population using a density-dependent Leslie matrix. The method involves the two constraints that the population be at equilibrium and that the index of absolute population size in the density-dependent function be assigned a value. In addition, given the probability of survival for age-class O, it is shown that the probability of survival through a selected life stage within age-class O can be indirectly determined. Three problems in modeling a fish population using a Leslie model are discussed in light of the difficulties involved in modeling density dependence due to insufficient information and lack of understanding concerning density-dependent phenomena.

4927 Postglacial rates of sedimentation, nutrient, and fossil pigment deposition in a hardwater marl lake of Michigan. Wetzel, R.G.; Manny, B.A. (Michigan State Univ., Hickory Corners). *Pol. Arch. Hydrobiol.;* **25**: No. 1-2, 453-469(1978).

Pigment products, N, P, organic matter, carbonate, and metals were analyzed in postglacial sediments of a small, deep hardwater lake. Focusing of sediments to the steeply-sloping central depression caused much more rapid sedimentation rates in the early postglacial history than in recent times. Carbonates constituted nearly 40% of the sediments until late in the third millennium. This reduction to 10% $CaCO_3$ in recent times coincided with abrupt increases in pigment derivatives, organic matter, Fe, Mn, and organic nitrogen. P content was directly related to carbonates and inversely to indices of productivity. Recent deforestation accelerated carbonate leaching and set into operation a number of nutrient interactions that suppressed phytoplanktonic and increased littoral productivity.

RADIOMETRIC TECHNIQUES

4928 Annual periodicity of the $^{18}O/^{16}O$ and $^{13}C/^{12}C$ ratios in the coral Montastrea annularis. Fairbanks, R.G. (Lamont-Doherty Geological Observatory, Palisades, NY); Dodge, R.E. *Geochim. Cosmochim. Acta;* **43**: No. 7, 1009-1020(Jul 1979).

The isotopic ratios $^{18}O/^{16}O$ and $^{13}C/^{12}C$ show an annual periodicity in the coral Montastrea annularis from Bermuda, Jamaica, and Barbados. The abundances of ^{18}O and ^{13}C are positively correlated in the Jamaica and Barbados samples, but inversely related in the Bermuda sample. Annual high density growth bands are formed during the season of warmest water temperature at all 3 sites and are enriched in ^{18}O. M. annularis has a constant displacement from oxygen isotopic equilibrium and accurately records seasonal temperature variations via the temperature-dependent aragonite-water fractionation factor. Light intensity, through the activity of the coral's endosymbiotic algae, regulates the depth-dependent and seasonal variations in the skeletal carbon isotopic composition. 5 figures, 2 tables.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 3996, 4020, 4021, 4023, 4901, 5005, 5009, 5011, 5014

4929 (COO—2958-3) Methods for the isolation and identification of polycyclic aromatic hydrocarbons found in complex mixtures and the determination of their possible toxicity by means of bioassay techniques. Progress report, August 1, 1978-August 1979. Lipsky, S.R.; McMurray, W.J. (Yale Univ., New Haven, CT (USA). School of Medicine). Aug 1979. Contract EY-76-S-02-2958. 24p. Dep. NTIS, PC A02/MF A01.

After electronic instrument difficulties, a computer controlled gas chromatography-mass spectrometer has been delivered, installed and is operational. Data gathering is commencing from adipose tissue obtained by needle biopsy. Materials under consideration include shale oil extracts, their dimethyl sulfoxide extracts and

product waters. A chart of individual identified PAH's is given. (PCS)

4930 (NTIS/PS—79/0311) **Oil slick movement (a bibliography with abstracts). Report for 1964-March 1979.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 42p. NTIS PC N01/MF N01.

The bibliography cites Government-sponsored research reports covering the movement of oil slicks in the ocean. Some of the topics include ocean current interactions, modeling of drift, ocean wave dispersion, and ocean current studies near various coasts.

4931 (PB—290347) **Development of a sorbent distribution and recovery system. Final report.** Shaw, S.H.; Bishop, R.P.; Powers, R.J. (Seaward International, Inc., Falls Church, VA (USA)). Nov 1978. Contract EPA-68-03-2138. 78p. NTIS PC A05/MF A01.

This report describes the design, fabrication, and test of a prototype system for the recovery of spilled oil from the surface of river, estuarine, and harbor waters. The system utilizes an open cell polyurethane foam in small cubes to absorb the floating oil. The system is highly mobile and can be transported in two pickup trucks. The sorbent is transported and distributed over the water surface by means of a pneumatic broadcaster. An inclined, open wire mesh belt conveyor is used to remove the saturated sorbent from the water. The recovered oil and water is removed from the sorbent by squeezing in a convérging belt press or regenerator. After regeneration, the foam is reapplied to the oil slick. The foam can be reused for a great many cycles. Tests of the system, using both diesel fuel and lubricating oil, were conducted at EPA's OHMSETT facility. The sweep speeds ranged up to 5 knots in both calm water and waves. Oil collection rates of 10.5 cubic meters/h were achieved. The oil content of the recovered liquid varied from 38% to 79%.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 4912

WATER

REFER ALSO TO CITATION(S) 4077

4932 (UCRL—82789) **Problems associated with transuranium determination of suspended solids in seawater samples.** Wong, K.M.; Jokela, T.A.; Noshkin, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Oct 1979. Contract W-7405-ENG-48. 9p. (CONF-791049—2). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

Particulate material collected by filtration from the north Equatorial Pacific Ocean has been analyzed for plutonium and other radionuclides. Different filter pore size, types of filter substrates, flow rates, and sample volumes were evaluated. Retention of $^{239+240}$Pu was found to vary with the sample volume filtered and was not greatly affected by the type of filter substrate, flow rate, or porosity tested. About 7 +- 3% of the $^{239+240}$Pu activity in north Equatorial Pacific surface water is found with the particulate material filtered from 120 liters of water, while less than 1% is retained on samples with volume of 20,000-70,000 liters. Clearly an understanding of these results is necessary to correctly assess the quantity of plutonium, other radionuclides and trace elements associated with and transported by particulate material in the marine environment.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 4918

4933 **Distribution of ^{238}Pu in tissues of fish from the canal in Miamisburg, Oho.** Kennedy, C.W.; Bartelt, G.E. (Argonne National Lab., IL). *Environ. Res.;* 17: 228-235(1978).

The ^{238}Pu concentrations of varous tissues were measured for seven species of freshwater fish from an ecosystem containing elevated levels of ^{238}Pu. The highest levels of ^{238}Pu were found in the gastrointestinal tracts and gills, while the lowest levels were found in muscle tissue. A rapid uptake of ^{238}Pu was observed for hatchery bluegills introduced into this system. High plutonium concentrations in the gastrointestinal tracts and gills suggest that these organs are potential uptake sites. The presence of ^{238}Pu in certain tissues (liver, gonads, bone, and muscle) indicates that there is a translocation of ^{238}Pu from the uptake sites.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

4934 (DOE-tr—191) **Rheinhausen measurement station for the investigation of heat transfer in flowing waters.** Hoffmann, G.; Sauter, H.; Schikarski, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). Feb 1977. Translation of KFK—2374. 49p. Dep. NTIS, PC A03/MF A01.

The objectives of the project are explained, and the tasks for the measurement station in the Rhine are cited. The site and the construction facilities are described, as well as the technical design of those details which are closely related to the measurement technology. A survey is given of the instrumentation and data acquisition facilities, both of which strongly depend on the chosen measurement methods. The most suitable measurement methods are discussed. Typical preliminary measurement results from this station are indicated, and the manner of their planned further evaluation is explained. Data processing, initial results, and further planned evaluations are presented.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 4479

4935 (PB—293307) **Factors associated with accuracy in sampling fish eggs and larvae.** Bowles, R.R.; Merriner, J.V.; Grant, G.C. (Virginia Inst. of Marine Science, Gloucester Point (USA)). Oct 1978. Contract DI-14-16-0008-2118. 94p. NTIS PC A05/MF A01.

The scope of this technical report covers four factors: (1) Gear currently used to sample ichthyoplankton; (2) sources of error associated with collection of ichthyoplankton samples used to assess power plant entrainment mortality; (3) abiotic and biotic factors that may affect attainment of 'representative' samples; and (4) factors that should be considered in the design or evaluation of ichthyoplankton sampling gear.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 4211

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 4072

4936 **Air pollution retrofit study: emission control for oil-fired power plants in the South Coast Air Basin.** Crommie, M.F. Sacramento, CA; California Energy Commission (1979). 57p. (NP—24131).

The South Coast Air Basin includes all of Orange County and portions of Los Angeles, San Bernardino, and Riverside Counties. The California Energy Commission is mandated by the Warren-Alquist Act to maintain adequate and reliable supplies of electricity, and to protect environmental quality standards. The potential costs of complying with newly evolving regulatory constraints on electric power plant operation are examined. The capital and operating costs that may be incurred in retrofitting existing oil-fired power plants in the South Coast Air Basin to control emissions of oxides of nitrogen (NO/sub x/) and oxides of sulfur (SO/sub x/) are examined. In addition, state-of-the art NO/sub x/ and SO/sub x/ emission control systems are evaluated. In particular, questions of technical feasibility, commercial demonstration, and reliability of performance are addressed. This assessment also includes quantitative estimates of construction lead time, construction down time requirements for application to utility systems and energy penalties associated with the process of retrofitting and the operation of the retrofitted power plants. This study is divided into three major areas: regulatory requirements; technology and economic analyses; and power plant specific data. The test of the most pertinent regulations and technical descriptions of applicable control systems are included in the appendices. (JGB)

4937 (ORNL/TM—6694) **Energy technology impacts on agriculture with a bibliography of models for impact assessment on crop ecosystems.** Rupp, E.M.; Luxmoore, R.J.; Parzyck, D.C. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 98p. Dep. NTIS, PC A05/MF A01.

Possible impacts of energy technologies on agriculture are evaluated, and some of the available simulation models that can be used for predictive purposes are identified. An overview of energy

technologies and impacts on the environment is presented to provide a framework for the commentary on the models. Coal combustion is shown to have major impacts on the environment and these will continue into the next century according to current Department of Energy projections. Air pollution effects will thus remain as the major impacts on crop ecosystems. Two hundred reports were evaluated, representing a wide range of models increasing in complexity from mathematical functions (fitted to data) through parametric models (which represent phenomena without describing the mechanisms) to mechanistic models (based on physical, chemical, and physiological principles). Many models were viewed as suitable for adaptation to technology assessment through the incorporation of representative dose-response relationships. It is clear that in many cases available models cannot be taken and directly applied in technology assessment. Very few models of air pollutant-crop interactions were identified, even though there is a considerable data base of pollutant effects on crops.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 4024, 4025, 4032

BIOMEDICAL SCIENCES, BASIC STUDIES

4938 Application of photosensitive devices to bioluminescence studies. Reynolds, G.T. (Princeton Univ., NJ). *Photochem. Photobiol.;* 27: 405-421(1978).

A brief review is given of some results obtained by the application of image intensification to studies of bioluminescence. The system consists of an image intensifier placed at the output of a suitable microscope, so that the image from the microscope falls on the intensifier cathode. The photon gain of the intensifier can be varied from a few thousand to one million. The output of the intensifier is recorded either on film or, in most applications to date, by means of a TV vidicon. The TV system permits display on a monitor in real time and simultaneous recording on magnetic tape for subsequent playback and analysis. It also provides time resolution for dynamic studies. Results are summarized for in vivo observations on Noctiluca miliaris, Obelia, Renilla, and Mnemiopsis leidyi. Utilization of the luminescence of aequorin in the presence of Ca^{2+} has been directed to observations on amoebae and the egg of the Medaka fish. Studies at the molecular level have been made by means of the spectral distribution of the output light. In these, the output of a fast input lens grating spectrometer is focused on the image intensifier cathode. Thus the entire visible spectrum of an in vivo bioluminescent flash can be intensified and recorded on film by photographing the output. The film is then analyzed by means of a digitized densitometer, and a computer program corrects the observed spectrum for system non-linearities and non-uniformities. In this way, the in vivo spectra of 15 bioluminescent species have been recorded.

4939 On the similarity of dendrograms. Watherman, M.S. (Los Alamos Scientific Lab., NM); Smith, T.F. *J. Theor. Biol.;* 73: 789-800(1978).

A metric on binary trees is defined to give the similarity of two dendrograms. One of the major desirable properties of the proposed tree similarity measure is to clarify the decision ordering nature of biological trees. This metric is applied to evolutionary tree reconstructions and comparative embryogenesis. The mathematical properties of this metric are discussed, and an algorithm is proposed to compute the metric.

4940 Analysis of circadian rhythms of free-ranging mammals. Tester, J.R. (Univ. of Minnesota, Minneapolis). *Biotelemetry;* 4: 167-170(1978).

Circadian rhythms of animals have long been of interest to biologists. Data on activity of wild animals living under natural conditions have been mostly anecdotal, whereas detailed information has been obtained from many species in captivity. Analyses of these later data have indicated remakably precise patterns of activity from day to day. Experimental studies have revealed an endogenous mechanism of timing which persists even in the absence of environmental stimuli. A classic example of both the precision and endogenous nature of such rhythms was provided by DeCoursey in her investigations of flying squirrels (Glaucomys volans). Development of telemetry techniques for monitoring the location of wild animals has made it possible, for the first time, to obtain data on rhythms of many species of vertebrates living under natural conditions for long periods of time. The purpose of this paper is to show how biotelemetry can be used to study activity patterns of free-ranging mammals. Seasonal changes in circadian rhythms in gray squirrels (Sciurus carolinensis) are used to illustrate methods of analyzing the data obtained by biotelemetry.

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 4479, 4921

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 4771, 4772, 4956, 4960, 4961, 4978, 4982, 4983, 4985, 5006, 5007, 5013

4941 DNA repair in xeroderma pigmentosum cells treated with combinations of ultraviolet radiation and N-acetoxy-2-acetylaminofluorene. Ahmed, F.E.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Cancer Res.;* 39: 471-479(Feb 1979).

Three techniques were used to examine excision repair in human cells treated with ultraviolet radiation, N-acetoxy-2-acetylaminofluorene, and a combination of the two. The three techniques gave similar results. Two types of human cells were used: (a) excision repair proficient (normal human fibroblasts and xeroderma pigmentosum variants); and (b) excision repair deficient (xeroderma pigmentosum, C, D, and E). Saturation doses were determined and used for combined treatments with both agents. We observed two patterns of repair: (a) in repair-proficient cells total repair was additive; and (b) in repair-deficient cells total repair was much less than additive (usually less than that observed for separate treatments) and N-acetocy-2-acetyl-aminofluorene inhibited excision of pyrimidine dimers. We conclude that, in the first group of cells, pathways for repair of ultraviolet radiation- and N-acetoxy-2-acetylaminofluorene-induced lesions are not identical and, in the second group of cells, there is an inhibitory effect exerted by major or minor products of each agent on the repair enzyme(s) of the other.

4942 (SRO—635-7) Mechanism of energy conversion and transfer in bioluminescence. Final report. Cormier, M.J. (Georgia Univ., Athens (USA). Dept. of Biochemistry). 1979. Contract EY-76-S-09-0635. 20p. Dep. NTIS, PC A02/MF A01.

Bioluminescence in the sea pansy, Renilla reniformis, a marine anthozoan coelenterate, is a complex process involving the participation of three proteins specific to anthozoan coelenterate-type systems. These are: (1) the luciferin binding protein, (2) the enzyme luciferase, and (3) the green-fluorescent protein. Each of these have been purified and characterized and the structure of luciferin has been confirmed by synthesis. Luciferin binding protein ($BP\text{-}LH_2$) is a specific substrate binding protein which binds one molecule of coelenterate-type luciferin per molecule of protein and which then releases luciferin in the presence of Ca^{++}. Luciferase is the enzyme which catalyzes oxidation (by O_2) of coelenterate-type luciferin, leading to the production of CO_2 and enzyme-bound, excited-state oxyluciferin. Oxyluciferin may then emit blue light by a direct de-excitation pathway or may transfer excitation energy to the green-fluorescent protein (GFP). GFP is a non-catalytic accessory protein which accepts excitation energy from oxyluciferin, by radiationless energy transfer, and then emits green bioluminescence. The Renilla bioluminescence system is thus the first radiationless energy transfer system the individual components of which have been purified to homogeneity, characterized, and then reassembled in vitro with restoration of the energy transfer function.

4943 EPR properties of the reaction center of Rhodopseudomas gelatinosa in situ and in a detergent-solubilized form. Prince, R.C. (Univ. of Pennsylvania, Philadelphia); Dutton, P.L.; Clayton, B.J.; Clayton, R.K. *Biochim. Biophys. Acta;* 502: 354-358(1978).

The photochemical reaction centers from a variety of purple photosynthetic bacteria are composed of a trimer of protein subunits. However, the recently isolated reaction center from Rhodopseudomonas gelatinosa appears to have only two subunits. The electron paramagnetic resonance (EPR) characteristics of the primary photochemical reactants in this species are examined and compared with those of other species. Despite the differences in protein composition, no dramatic differences in EPR properties are seen in vivo, although some interesting effects are seen upon solubilization of the reaction center, which may be related to the unusual lability of the isolated preparation. Perhaps the most noteworthy phenomenon seen in Rps. gelatinosa is the apparent ability of electrons on the reduced intermediary electron carrier to tunnel at low temperatures to the oxidized c-type cytochrome, which has not been seen in other species studied to date.

4944 Singular perturbation approach to diffusion reaction equations containing a point source, with application to the hemolytic plaque assay. Perelson, A.S. (Los Alamos Scientific Lab., NM); Segel, L.A. *J. Math. Biol.;* 6: 75-85(1978).

Many cells secrete factors which diffuse and bind to receptors on neighboring cells. These processes can be described by a nonlinear diffusion equation with a point source and a spatially distributed binding reaction. We show via perturbation analysis how approximate solutions can be obtained for such equations when the binding reaction is fast compared to diffusive transport. We base our analysis on an example which is of great practical importance in immunology, the hemolytic plaque technique.

4945 Biochemical actions of glucocorticoids on macrophages in culture. Specific inhibition of elastase, collagenase, and plasminogen activator secretion and effects on other metabolic functions. Werb, Z. (Univ. of California, San Francisco). *J. Exp. Med.;* **147**: 1695-1712(1978).

The effects of glucocorticoids on biochemical functions of macrophages from man, mouse, rabbit, and guinea pig were examined. Secretion of plasminogen activator by human peripheral blood monocytes was decreased 50% with 1 nM dexamethasone. Differentiation of murine monocytic and granulocytic colonies in agar from bone marrow precursors was decreased 50% at 7 days with 20 nM dexamethasone. Secretion of elastase, collagenase, and plasminogen activator by resident and thioglycollate-elicited mouse peritoneal macrophages was decreased by dexamethasone, cortisol, and triamcinolone acetonide (1 to 1,000 nM), but not by progesterone, estradiol, and dihydrotestosterone (1,000 nM); in contast, secretion of lysozyme was not affected by glucocorticoids. The inhibition of macrophage secretion by dexamethasone was both time and dose dependent. Inhibition of macrophage secretion increased with increasing glucocorticoid concentration. Half-maximum inhibition of secretion of elastase, collagenase, and plasminogen activator was seen at dexamethasone concentrations (1 to 10 nM) similar to those that half-saturated the specific glucocorticoid receptors. At high concentrations of dexamethasone (100 to 1,000 nM) the secretion of plasminogen activator was inhibited to a greater extent (>95%) than the secretion of elastase (60 to 80%).Progesterone alone had no effect on secretion, but blocked the inhibitory effects of dexamethasone and cortisol. Secretion of collagenase, neutral proteinases, and plasminogen activator by elicited rabbit alveolar macrophages was inhibited with glucocorticoids (0.1 to 100 nM) but not with progesterone or sex steroids. Secretion of a neutral elastinolytic proteinase by guinea pig alveolar macrophages was also inhibited by dexamethasone.

4946 Enzymatic oxidation of mercury vapor by erythrocytes. Halbach, S.; Clarkson, T.W. (Univ. of Rochester, NY). *Biochim. Biophys. Acta;* **523**: 525-531(1978).

The formation of glutathione radicals, the evolution of nascent oxygen or the peroxidatic reaction with catalase complex I are considered as possible mechanisms for the oxidation of mercury vapor by red blood cells. To select among these, the uptake of atomic mercury by erythrocytes from different species was studied and related to their various activities of catalase (hydrogen-peroxide:hydrogen-peroxide oxidoreductase, EC 1.11.1.6) and glutathione peroxidase (glutathione:hydrogen-peroxide oxidoreductase, EC 1.11.1.9). A slow and continuouus infusion of diluted H_2O_2 was used to maintain steady concentrations of complex I. 1% red cell suspensions were found most suitable showing high rates of Hg uptake and yielding still enough cells for subsequent determinations. The results indicate that the oxidation of mercury depends upon the H_2O_2-generation rate and upon the specific acticity of red-cell catalase. The oxidation occurred in a range of the catalase-H_2O_2 reaction where the evolution of oxygen could be excluded. Compounds reacting with complex I were shown to be effective inhibitors of the mercury uptake. GSH-peroxidase did not participate in the oxidation but rather, was found to inhibit it by competing with catalase for hydrogen peroxide. These findings support the view that elemental mercury is oxidized in erythrocytes by a peroxidatic reaction with complex I only.

4947 1,25-dihydroxyvitamin D_3 metabolism. The effect of dietary calcium and phosphorus. Ribovich, M.L.; DeLuca, H.F. (Univ. of Wisconsin, Madison). *Arch. Biochem. Biophys.;* **188**: No. 1, 164-171(1978).

Rats maintained on tritiated 1,25-dihydroxyvitamin D_3 as their sole source of vitamin D and placed on diets differing in calcium content had similar intestinal levels of tritiated 1,25-dihydroxyvitamin D_3. Since 1,25-dihydroxyvitamin D_3 administration eliminated adaptation of intestinal calcium transport, it appears that increased production of 1,25-dihydroxyvitamin D_3 is responsible for the stimulation of calcium transport by low dietary calcium. When maintained on tritiated, 1,25-dihydroxyvitamin D_3, rats fed a low-phosphorus diet had somewhat higher levels of tritiated 1,25-dihydroxyvitamin D_3 in the duodenum and plasma than rats on a normal-phosphorus diet. In addition to stimulating 1,25-dihydroxyvitamin D_3 synthesis, low dietary phosphorus may increase the accumulation of 1,25-dihydroxyvitamin D_3 in both intestine and plasma.

4948 Horomonal nature of vitamin D function. DeLuca, H.F. (Univ. of Wisconsin, Madison). pp 249-270 of Hormones and cell regulation. Vol. 2. Dumont, J.; Nunez, J. (eds.). New York, NY; Elseiver North Holland Biomedical Press (1978).

Vitamin D_3 is a prohormone normally produced in the skin by photolysis of 7-dehydrocholesterol. It becomes activated by 25-hydroxylation in the liver. The kidney then serves as an endocrine organ converting it to the hormone 1,25-dihydroxy-vitamin D_3. This conversion is stimulated by the parathyroid hormone. Hypophosphatemia also causes accumulation of 1,25-dihydroxyvitamin D_3 in blood and target tissues. Furthermore other hormones such as the sex hormones, prolactin, and growth hormone also stimulate the production of 1,25-dihydroxyvitamin D_3 to meet extraordinary needs for calcium. The 1α-hydroxylase is a mixed fundtion P-450 system similar to the adrenal steroid systems and further the 1,25-dihydroxy-vitamin D_3 acts through a receptor mechanism to stimulate intestinal calcium and phosphorus absorption and the mobilization of calcium and phosphate from bone.

4949 Structure of plant cell walls. VIII. A new pectic polysaccharide. Darvill, A.G.; McNeil, M.; Albersheim, P. (Univ. of Colorado, Boulder). Contract EY-76-S-02-1426. *Plant Physiol.;* **62**: 418-422(1978).

This paper describes the isolation and characterization of rhamnogalacturonan II, a hitherto unobserved component of the primary cell walls of dicotyledonous plants. Rhamnogalacturonan II constitutes 3 to 4% of the primary cell walls of suspension-cultured sycamore (Acer pseudoplatanus) cells. Rhamnogalacturonan II is a very complex polysaccharide yielding, upon hydrolysis, 10 different monosaccharides including the rarely observed sugars apiose, 2-O-methylxylose, and 2-O-methylfucose. In addition, rhamnogalacturonan II is characterized by the rarely observed glycosyl interconnections of 2-linked glucuronosyl, 3,4-linked fucosyl, and 3-linked rhamnosyl residues. These glycosyl linkages have never previously been detected in primary sycamore cell walls. Evidence is presented which suggests that polysaccharides similar to rhamnogalacturonan II are present in the primary cell walls of the three other dicotyledonous plants examined.

4950 Mediation of calcium adaptation by 1,25-dihydroxycholecalciferol. Omdahl, J.L. (Univ. of New Mexico, Albuquerque); DeLuca, H.F. *J. Nutr.;* **107**: No. 11, 1975-1980(Nov 1977).

Vitamin D-depleted chicks which were repleted with 25-hydroxycholecalciferol adapted to the feeding of a low or high calcium diet by respectively increasing or decreasing their rate of intestinal calcium absorption. The synthesis of 1,25-dihydroxycholecalciferol in chicks fed differing calcium diets correlated directly with intestinal calcium absorption activity, suggesting that the intestinal calcium adaptation response is medicated by the modulation of kidney 25-hydroxycholecalciferol-1-hydroxylase activity. This view was strongly supported by the demonstration that repletion of the chicks with 1,25-dihydroxycholecalciferol eliminated the ability of the chicks to adjust their rates of intestinal calcium absorption to dietary levels of calcium.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 4964, 4975, 5003

4951 (ORO—4310-16) **Primary light harvesting system: phycobilisomes and associated membranes.** Gantt, E. (Smithsonian Institution, Rockville, MD (USA). Radiation Biology Lab.). 1979. Contract EY-76-S-05-4310. 8p. Dep. NTIS, PC A02/MF A01.

A comparison of the phycobilisome structure from evolutionary lower and higher red algae showed that their phycobilisome size and shape varied, but that the arrangement within the phycobilisomes was essentially the same. Allophycocyanin, the terminal phycobiliprotein in the energy transfer chain to chlorophyll, has been investigated. Two of the four allophycocyanin forms from Nostoc (cyanophyte) phycobilisomes, allophycocyanin-I and -B are the probable bridging pigments between the phycobilisomes and the photosynthetic lamellae because they have the longest absorbance and fluorescence emission forms. With procedures developed in this laboratory, vesicles with functionally attached phycobilisomes have been obtained from red and blue-green algae. These preparations have oxygen evolution rates comparable to whole cells, and show energy transfer from phycoerythrin to PS II chlorophyll with a high 695 nm (-196°C) emission. With the availability of such preparations, and the capability of isolating phycobilisomes, probes for the phycobilisome attachment site can be undertaken. Complexes from phycobilisomes consisting of phycoerythrin and phycocyanin, which could be dissociated and recombined were further characterized. Additional polypeptide bands (with SDS-PAGE) were found only with the recombinable phycobiliprotein fractions. These polypeptides probably function in stabilizing the phycobilisome structure.

4952 Cessation of respiration after far-ultraviolet irradiation of Escherichia coli B/r: loss of unaltered pyridine nucleotides to the medium. Schenley, R.L. (Oak Ridge National Lab., TN); Swenson,

P.A.; Joshi, J.G. Contract W-7405-ENG-26. *Radiat. Res.;* **79**: No. 3, 611-621(Sep 1979).

Cessation of respiration of Escherichia coli B/r cells is initiated 30 min after irradiation at 254 nm and is linked to cell death. Pyridine nucleotides begin to disappear with the onset of respiratory failure and are almost completely absent from the cells by 90 min after irradiation. We studied the fate of these respiratory cofactors in a niacin-requiring mutant (RSI) grown on minimal medium containing [7-^{14}C]nicotinic acid. By 90 min after irradiation (52 J/m^2) nearly all of the acid-soluble radioactive counts appeared in the medium. Paper chromatographic studies and a spectrophotometric assay indicated that the material was nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate. The loss of nicotinamide adenine dinucleotide was not balanced by synthesis, despite the presence of appropriate active biosynthetic enzymes for at least 90 min after uv irradiation. Analysis of the amino acid and nucleotide pool of the cells showed that there was some loss of most of these small molecules; the levels of a few were almost completely depleted. We conclude that the pyridine nucleotides are lost from the cell to the medium and that the loss cannot be attributed to extensive general membrane damage.

4953 Oxygens in DNA are main targets for ethylnitrosourea in normal and xeroderma pigmentosum fibroblasts and fetal rat brain cells. Singer, B. (Univ. of California, Berkeley); Bodell, W.J.; Cleaver, J.E.; Thomas, G.H.; Rajewsky, M.F.; Thon, W. Contract EY-76-C-03-1012-429. *Nature (London);* **276**: No. 5683, 85-88(2 Nov 1978).

One of the major problems in the study of chemical carcinogenesis is to identify in cells or animals the nucleic acid adducts known from in vitro experiments. When normal or xeroderma pigmentosum (XP) human fibroblasts or fetal rat brain cells (FBC) in culture are treated with the carcinogen, ethylnitrosourea (EtNU), to an extent permitting good cell survival (2-5 ethyl groups per 100,000 bases), it is found that the nature and proportion of the alkyl products in their DNA are remarkably similar to those found when DNA is alkylated with EtNU to a high extent in vitro (1 ethyl group per 100 bases). The products quantified in this study are ethylphosphotriesters, 7-ethylguanine (7-EtG), 3-ethyladenine (3-EtA), O^6-ethyl deoxyguanosine (O^6-EtdGuo), O^2-EtThd), O^4-ethylthymidine and O^2-ethylcytosine (O^2-EtC). The first experimental evidence that pyrimidine oxygen atoms are major sites of reaction in cells treated with EtNU is presented. A comparison of the present model experiments with purified DNA and poly(dG) . poly(dC) with earlier studies on single-stranded polynucleotides indicates that Watson-Crick base-pairing does not significantly hinder alkylation of the oxygens. This is in contrast to previous findings concerning the very low reactivity of base-paired nitrogens. This is explained on the basis that only the oxygens have a pair of electrons not directly involved in hydrogen bonding.

4954 Informosomal and polysomal messenger RNA: differential kinetics of polyadenylation and nucleocytoplasmic transport in Chinese hamster ovary cells. Enger, M.D.; Hanners, J.L. (Univ. of California, Los Alamos, NM). *Biochim. Biophys. Acta;* **521**: 606-618(1978).

The relative kinetics of cytoplasmic appearance and polyadenylation were determined for informosomal (ribosome-free) and polysomal (ribosome-associated) mRNAs 17 to 20 min and into informosomal mRNA 2 to 5 min after addition of radio-labelled uridine. Adenosine appeared in polysomal mRNA 4 to 5 min before uridine. In contrast, adenosine label preceded uridine into informosomal mRNA by less than 1 min. About one-third of newly formed informosomal and two-thirds of newly formed polysomal mRNA are poly(A*). The data indicate that newly formed informosomal mRNA cannot be simple precursor to polysomal mRNA. Further, the pronounced difference in time required fo polyadenylation and cytoplasmic appearances of these messenger ribonucleoproteins suggests that there may be fundamental differences in their mode of processing.

CYTOLOGY

REFER ALSO TO CITATION(S) 4941, 4983, 5006

4955 (LA-UR—79-2557) **Theoretical models for the specific adhesion of cells to cells or to surfaces.** Bell, G.I. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 17p. (CONF-790764—1). Dep. NTIS, PC A02/MF A01.

From Conference on models of biological growth and spread; Heidelberg, F.R. Germany (Jul 1979).

Theoretical framework for analysis of cell adhesion mediated by specific molecular interactions is presented with recent experimental and theoretical work reviewed. (PCS)

4956 (UR—3490-1770) **Biomembrane modeling: molecular dynamics simulation of phospholipid monolayers.** Thompson, T.R. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 178p. Dep. NTIS, PC A09/MF A01.

Thesis.

As a first step toward a computer model of a biomembrane-like bilayer, a dynamic, deterministic model of a phospholipid monolayer has been constructed. The model moves phospholipid-like centers of force according to an integrated law of motion in finite difference form. Forces on each phospholipid analogue are derived from the gradient of the local potential, itself the sum of Coulombic and short-range terms. The Coulombic term is approximated by use of a finite-difference form of Poisson's equation, while the short-range term results from finite-radius, pairwise summation of a Lennard-Jones potential. Boundary potentials are treated in such a way that the model is effectively infinite in extent in the plane of the monolayer. The two-dimensional virial theorem is used to find the surface pressure of the monolayer as a function of molecular area. Pressure-versus-area curves for simulated monolayers are compared to those of real monolayers. Dependence of the simulator's behavior on Lennard-Jones parameters and the specific geometry of the molecular analogue is discussed. Implications for the physical theory of phospholipid monolayers and bilayers are developed.

4957 Microscopic observation of intracellular ice formation in unfertilized mouse ova as a function of cooling rate. Leibo, S.P.; McGrath, J.J.; Cravalho, E.G. (Oak Ridge National Lab., TN). *Cryobiology;* **15**: 257-271(1978).

A physical-chemical analysis of water loss from cells at subzero temperatures has shown that the likelihood of intracellular ice formation increased with increasing cooling rate. We have now used a modified version of a unique conduction-cooled cryomicroscope stage to observe the freezing of unfertilized mouse ova suspended in dimethyl sulfoxide. Survival measurements showed that the respective survivals of ova were about 65, 56, and 0% when they were cooled at rates of 0.2 to 1.5, 2.5, and 5.4°C/min. Direct microscopic observation of mouse ova during freezing showed that the respective fractions of cells that foze intracellularly were 13, 72, and 100% when they were cooled at rates of 1.3, 2.9, and 4.8°C/min or faster. These values agree with those predicted from the physical-chemical analysis for cells the size of mouse ova. The microscopic observations have also shown that intracellular freezing generally occurred at about -40 to -45°C. We had previously observed that mouse embryos must be cooled slowly to -50°C or below if they are to survive subsequent rapid cooling to -196°C. The observation of intracellular ice formation at -45°C supports the interpretation that at temperatures above -50°C the embryos still contain water capable of freezing intracellulary.

4958 Morphology of isolated mouse inner cell masses developing in vitro. Wiley, L.M.; Spindle, A.I.; Pedersen, R.A. (Univ. of California, San Francisco). *Dev. Biol.;* **63**: 1-10(1978).

The purpose of this study was to examine the developmental capacity of the mouse inner cell mass (ICM) in the absence of the trophoblast. ICMs were isolated from blastocysts by immunosurgery and cultured under conditions that support egg cylinder formation by intact blastocysts. After 2 or 3 days of culture, the ICMs consisted of an outer layer of endoderm and an inner layer of ectoderm that had cavitated centrally. By 4 or 5 days of culture, 25 to 60% of these ICMs had developed into paired cysts, apparently by secondary cavity formation. The inner cell layer surrounding this secondary cavity resembled the extraembryonic ectoderm of cultured egg cylinders. By 6 days of culture, 60% of the ICMs had expanded into yolk sac-like structures that subsequently produced capillaries containing blood cells. The ICMs appeared to develop mesoderm in two distinct ways. A few of them developed mesoderm as a third layer of cells in the cleft separating endoderm and ectoderm, presumably by migrating from the inner, ectodermal layer, through the primitive streak, as in the intact egg cylinder. In the rest of the ICMs the embryonic ectoderm gradually differentiated into mesoderm while still in the inner layer, without primitive streak formation. We suggest, therefore, that the continuous presence of the trophoblast or of its derivatives is not required for the cytodifferentiation of mesoderm although it may be important in establishing embryonic polarity or in providinginductive signals necessary for the morphogenetic aspects of mesoderm differentiation, specifically primitive streak formation.

4959 Proliferation of human lymphocytes in culture: determination by measurement of nuclear volume and cell number. Chandra, P.; Chanana, A.D.; Sipe, C.R.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). *Nouv. Rev. Fr. Hematol.;* **20**: No. 4, 545-555(1978).

Proliferation of stimulated human lymphocytes was studied in cultures by determining cell counts and nuclear volume enlargement. DNA content and the nuclear volume increase before the cell divides. Volume-frequency curves were obtained of unstimulated and phytohemagglutinin (PHA) stimulated lymphocytes on 0, 3, 6, and 9 days of cultures with the Coulter Counter H_4 system. As the number of lymphocytes in the cultures transformed and enlarged in volume, the area under the volume-frequency curve increased proportionately. The fraction of transforming cells was determined by

comparing the area under the curve of the unstimulated and the stimulated lymphocytes. This method provides both the fraction of cells transformed and the increment of the number of cells in the culture and is therefore a better indicator of cell proliferation than the commonly used isotope-labeled thymidine uptake method which monitors the fraction of the cells in DNA synthesis phase only.

4960 Reversed immunosorbents: a simple method for specific antibody immobilization. Levy, D.E.; Eveleigh, J.W. (Oak Ridge National Lab., TN). *J. Immunol. Methods;* **22**: 131-142(1978).

A method is presented for permanently converting an antigen immunosorbent into a purified antibody immunosorbent which retains specific reactivity for antigen. Following immunological reaction of the antibodies in an antiserum with the antigen adsorbent, the specific immunoglobulin is chemically bound to the antigen by means of a divalent cross-linking agent. Various such agents, including glutataldehyde, suberimidate, a diazide, and isocyanates, were employed. The conditions of preparation using the first two were optimized, and the characteristics of the resulting immobilized antibodies were investigated. Applications in radioimmunoassay, preparative chromatography, and affinity-constant studies are discussed in view of the unique attributes of these reagents.

4961 Mutagenicity of dimethylnitrosamine and ethyl methanesulfonate as determined by the host-mediated CHO/HGPRT assay. Hsie, A.W.; Machanoff, R.; Couch, D.B.; Holland, J.M. (Oak Ridge National Lab., TN). *Mutat. Res.;* **51**: 77-84(1978).

Host-mediated assays have been developed to allow determination of the mutagenic potential of promutagens and procarcinogens which require metabolic activation to exert their effects on indicator organisms. We report here the development of the host-(mouse)-mediated CHO/HGPRT system using the procarcinogen dimethylnitrosamine (DMN) as a model agent. Using a 2-h treatment time, we observed a linear dose-response relationship up to 250 mg of DMN per kg body weight. At 100 and 500 mg/kg DMN, mutation induction increased with time up to at least 6 h. DMN was not mutagenic when tested in vitro. Athymic (nude) mice, their phenotypically normal littermates, or BALB/c mice of both sexes were found to be suitable as hosts. A time- and dose-dependency of induced mutation frequency by a direct-acting agent, ethyl methanesulfonate (EMS), was observed in both the in vitro and the host-mediated assays.

4962 Data acquisition and display for a high-speed cell sorter. Salzman, G.C.; Hiebert, R.D.; Crowell, J.M. (Los Alamos Scientific Lab., NM). *Comput. Biomed. Res.;* **11**: 77-88(1978).

Data acquisition and control hardware and display and processing software are presented for a biological cell sorter in which the four parameters of information about each cell are stored event-by-event on a computer disk.

4963 Quantification of cell fusion by twenty-one strains of Newcastle disease virus using flow microfluorometry. Cram, L.S.; Forslund, J.C.; Jett, J.H. (Los Alamos Scientific Lab., NM). *J. Gen. Virol.;* **41**: 27-36(1978).

The cell-fusing ability of Newcastle disease virus (NDV) was quantified using flow microfluorometry (FMF). The rate of polykaryocyte formation, fusion dependence on multiplicity of infection, and cell fusion differences for 21 NDV strains were measured using this technique. No correlation was found between the virulence of a virus strain and its cell fusion index calculated from the FMF data.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 4953, 4975

4964 (UCLA—12-1219) **Spontaneous unscheduled DNA synthesis in human lymphocytes.** Forell, B.; Myers, L.S. Jr.; Norman, A. (California Univ., Los Angeles (USA)). 1979. Contract EY-76-C-03-0012. 22p. Dep. NTIS, PC A02/MF A01.

The rate of spontaneous unscheduled DNA synthesis in human lymphocytes was estimated from measurements of tritiated thymidine incorporation into double-stranded DNA (ds-DNA) during incubation of cells in vitro. The contribution of scheduled DNA synthesis to the observed incorporation was reduced by inhibiting replication with hydroxyurea and by separating freshly replicated single-stranded DNA (ss-DNA) from repaired ds-DNA by column chromatography. The residual contribution of scheduled DNA synthesis was estimated by observing effects on thymidine incorporation of: (a) increasing the rate of production of apurinic sites, and alternatively, (b) increasing the number of cells in S-phase. Corrections based on estimates of endogenous pool size were also made. The rate of spontaneous unscheduled DNA synthesis is estimated to be 490 +- 120 thymidine molecules incorporated per cell per hour. These results compare favorably with estimates made from rates of depurination and depyrimidination of DNA, measured in molecular systems if we assume thymidine is incorporated by a short patch mechanism which incorporates an average of four bases per lesion.

4965 Bisack analysis of the phytohaemagglutinin-induced proliferation of human peripheral lymphocytes. Tice, R.; Thorne, P.; Schneider, E.L. (Brookhaven National Lab., Upton, NY). *Cell Tissue Kinet.;* **12**: 1-9(1979).

The rate of stimulation as well as subsequent cell cycle duration was examined in phytohaemagglutinin-stimulated human peripheral lymphocytes grown in vitro in the presence of non-inhibitory concentrations of bromodeoxyuridine. After incorporation of this heavy atom analogue of thymidine into replicating cellular DNA, it was possible to identify unequivocally metaphase cells which had replicated for one, two and three or more cell cycles. Utilizing this technique, distribution curves were obtained for the appearance of metaphase cells in successive generations, were analyzed by a computer simulation model, and the rate of stimulation (4.5% per hr of the remaining unstimulated population) and cell cycle duration (12.3 hr) were determined. The results were compared with those obtained by autoradiography and the possible relationship to the transition probability model for cellular proliferation is discussed.

4966 Progenitor cells of erythroblasts: an in vitro investigation of erythropoietin-responsive cells of guinea pig bone marrow. Rosse, C.; Beaufait, D.W. (Washington Univ., Seattle). *Anat. Rec.;* **191**: No. 2, 135-145(Jun 1978).

The experiments were designed to therst whether erythroblast progenitor cell function could be demonstrated in a morphological cell type designated as transitional cells. Two cell fractions were obtained from the bone marrow of normal and polycythemic guinea pigs. One fraction (F1) was enriched in transitional cells and contained few other cell types which could be considered as candidates for erythropoietin responsive cells (ERC). The other fraction (F2) contained undifferentiated blast cells as well as transitional cells. The effect of human urinary erythropoiesis stimulating factors (ESF) on heme synthesis was compared in these two fractions by measuring ^{59}Fe incorporation into heme. ESF was more effective in stimulating heme synthesis in guinea pig bone marrow cells than homologous sera obtained from anemic or hypoxic animals. The majority of ERC sedimented in F2, but the stimulation index was comparable in the two fractions. It was confirmed by radioautography that the ESF response in F1 was due to the generation of proerythroblasts and basophilic erythroblasts that incorporated ^{59}Fe. The generation of these cells in F1 was dependent on the addition of ESF to the cultures, whereas ^{59}Fe-labeled erythroblasts were recovered from cultures of F2 not supplemented with ESF. ESF induced a proportion of transitional cells to incorporate ^{59}Fe in both F1 and F2. Transitional cells were the only cell type in which heme synthesis was dependent on ESF. Radioautography with ^{59}Fe identified a proportion of these cells as ERC in both F1 and F2 fractions of bone marrow obtained from normal and polycythemic guinea pigs. The present studies show that some transitional cells function as progenitors of erythroblasts because they respond to ESF by initiation of heme synthesis and by transformation into the earliest recognizable erythroid cells.

4967 Differentiation of B and T lymphocytes from precursor cells resident in the bone marrow. Rosse, C.; Press, O.W. (Washington Univ., Seattle). *Blood Cells;* **4**: 65-85(1978).

A series of experiments in guinea pigs and mice established that proliferating progenitor cells for B and T lymphocytes are a resident population in the bone marrow. It was shown by the combined use of ^{3}H-TdR radioautography and fluorescent-antibody staining of B and T cells that the majority of bone marrow (BM) lymphocytes are rapidly renewed (RR) B cells and null cells, whereas the thymus (THY) consists overwhelming of RR T lymphocytes; in spleen (SPL) and lymph node (LN) slowly renewed (SR) T and B cells predominate. The rate of B cell turnover in guinea pig bone marrow exceeds that in the SPL or LN, and the appearance of newly generated B cells in the SPL lags behind that in the BM. When systematically administered ^{3}H-TdR was excluded by tourniquets from tibial and femoral BM no labeled B cells appeared in tibial or femoral marrow over 72 h. When tibial and femoral BM was labeled selectively with ^{3}H-TdR, labeled B cells appeared in the SPL and LN over 72 h. (It was found in CBA mice that BM cell fractions enriched in lymphocytes (BML) responded to the T cell mitogen PHA in a manner qualitatively different from the response of SPL and LN cells. Experiments with athymic nude mice and with complement-mediated lysis of T and B cells established that PHA responsive cells in SPL and LN were T cells but in BML they were null lymphocytes. Target cells of PHA in BML responded to the mitogen by the generation of T-cell surface markers and blastogenesis; therefore they were identified as pre-T cells. BM pre-T cells are rapidly renewed and, in contrast to PHA responsive cells of SPL and LN, do not recirculate from blood to lymph. Both B and pre-T cells in the BM are division products of transitional cells. Among transitional cells of the marrow are included the progenitors of B and T lmyphhocytes and of all other types of hemopoietic cells.

GENETICS

REFER ALSO TO CITATION(S) 4971

4968 (BNL—26438) **Cloning of zein sequences and an approach to zein genetics.** Burr, F.A.; Burr, B. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790750—1). Dep. NTIS, PC A02/MF A01.

From NATP advance study institute on genome organ. and exp. in higher plants; Edinburgh, UK (11 Jul 1979).

Examination of internal restriction endonuclease sites of the cloned sequences indicates that there are possibly a minimum of three heavy chain sequences and four light chain sequences. These results are being confirmed by hybridization to restriction cut DNA immobilized on filters, and more extensive restriction mapping of the cloned sequences themselves. If these preliminary results are borne out, the consequences for mutation breeding to improve endosperm protein quality by intervention at the zein structural gene loci become problematical. If there are multiple genes, detection of amino acid substitutions at the various loci and recombination to create multiple substitutions at a given locus would be nearly impossible by conventional techniques. Furthermore, should a method be found to accomplish this goal, and the multiple genes turn out to be unlike, as seems likely, their uniform transfer to inbred backgrounds for the production of hybrid seed adapted to various environments would be very difficult to achieve. (PCS)

4969 (BNL—26596) **Last of the T phages.** Studier, F.W. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 19p. (CONF-7811140—1). Dep. NTIS, PC A02/MF A01.

From Symposium on genes, cells and behavior: a view of biology fifty years later; Pasadena, CA, USA (1 Nov 1978).

Results clearly show that it is possible to induce mutations in T7 DNA at a physically measurable rate in the laboratory, and to follow genetic divergence by restriction analysis. The rate of accumulation of changes in the presence of mutagen is high enough that it may be feasible to induce changes at least as great as those found among the T7-related phages isolated from nature.

4970 **Utility of specific locus systems in higher plants to monitor for mutagens.** Constantin, M.J. (Comparative Animal Research Lab., Oak Ridge, TN). Contract EY-76-C-05-0242. *Environ. Health Perspect.;* **27**: 69-75(Dec 1978).

Plants possess biological and operational attributes that have encouraged geneticists to use them extensively in the development of fundamental genetic concepts. Attributes such as regenerative plasticity, high fecundity, cultural adaptability, range of ploidy, economics of culture and maintenance of specific populations, and versatility make plant genetic systems prime candidates with which to monitor the environment for mutagens. A specific locus (equivalent to a classical Mendelian gene) controls the development of a phenotypic characteristic. It can also mutate to a new allelic form with a consequentially altered phenotypic characteristic and can be separated by crossing over from adjacent loci that govern other specific phenotypic characteristics. Since various plant species have numerous specific loci, one has a rich array of potential systems from which to select. Specific locus systems in higher plants could be used to assess the mutagenicity of single chemical compounds or combinations of chemical compounds. Depending on the circumstances, seeds and/or seedlings could be used; plants could be grown in situ in either containers or plots to assess the immediate environment for one or more mutagens over an extended period. Since plants are eucaryotes, data from such experiments could serve as one more source of information along with that obtained from a battery of other tests used in the tier system.

METABOLISM

REFER ALSO TO CITATION(S) 4946, 4989, 5014

4971 **Genetic relation of life span to metabolic rate for inbred mouse strains and their hybrids.** Sacher, G.A.; Duffy, P.H. (Argonne National Lab., IL). *Fed. Proc.;* **38**: No. 2, 184-188(Feb 1979).

Average life spans were estimated for the male progeny from 21 of the 25 possible matings of 5 inbred mouse strains. Oxygen consumption was measured in an open system over a 48-hour interval. Resting metabolism, M/sub re/, and average metabolism, M/sub av/, were determined at 6 to 8 months of age, and at 24 to 34 months. Body weight, W, was determined at the time metabolism was measured. Life span, L, is negatively correlated with M/sub re/ and M/sub av/, and positively correlated with W at both ages of measurement. This is in accord with the metabolic wear factor that had previously been established among 85 different species of mammals. A new metabolism variable, the energy partition coefficient, defined as the ratio of average to resting metabolic rate, M/sub av//M/sub re/, has a parabolic relation to body weight, i.e., is maximal at an intermediate body size. The squared body weight deviation in turn has a negative correlation with life span. The correlation of L with M/sub av//M/sub re/ is positive, as expected, but not significant. These data suggest the existence of a longevity factor dependent on the partition of energy between the phasic metabolism of activity and the continuous maintenance metabolism.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 4951, 5003

MEDICINE

4972 **Surgical adjuvant immunotherapy for colorectal cancer.** Enker, W.E.; Jacobitz, J.L.; Craft, K.; Wissler, R.W. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *J. Surg. Oncol.;* **10**: 389-397(1978).

One hundred forty-four Wistar-Furth rats in 12 therapeutic groups have been studied in a long-term comparison of the effectiveness of nonspecific immunotherapy with MER (methanol extraction residue) vs active-specific immunotherapy with neuraminidase-modified tumor cells. Six months after surgical adjuvant immunotherapy a 100% improvement in survival was achieved with MER immunotherapy compared to untreated control animals. In addition, the use of MER enhanced the value of active-specific immunotherapy where both modalities were combined in sequence. The predicted value of MER-BCG (Bacillus Calmette-Guerin) for the immunotherapy of solid tumors was borne out by these results suggesting that present ongoing clinical trials of MER as adjuvant therapy for large bowel cancer should prove to be successful if properly controlled. The pattern of survival in these experiments suggests that surgical adjuvant immunotherapy is cytostatic rather than cytocidal, and implies the need for long-term, repeated immunizations.

4973 **Longitudinal study of blood pressure in the Japanese, 1958 to 1972.** Dock, D.S.; Fukushima, K. (Radiation Effects Research Foundation, Hiroshima, Japan). *J. Chronic Dis.;* **31**: 669-689(1978).

Blood pressure data with related medical and demographic information from a longitudinal study of a Japanese cohort are presented. The role of suspected hypertension risk factors including age, sex, initial pressure levels and body weight in determining the probability of further pressure elevation was examined. Only a minority of mild hypertensives progressed into the severe category during the decade under study, with initial pressures and age being of greatest predictive importance. Despite a relationship between weight and blood pressure, and although a general increase in body stature was observed, mean pressures were not seen to rise as predicted among individuals of a given age group in the early 1970's when compared to subjects of the same age a decade earlier. There was a distinct excess risk for subsequent pressure rise among those with transient early labile hypertension. While there was a correlation between blood pressure and both weight and cardiovascular mortality, excess weight did not appear to have an independent effect upon the latter.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 4994

4974 **Quantitative scanning of osteogenic sarcoma with nitrogen-13-labeled L-glutamate.** Gelbard, A.S.; Benua, R.S.; Laughlin, J.S.; Rosen, G.; Reiman, R.E.; McDonald, J.M. (Memorial Sloan-Kettering Cancer Center, New York, NY). *J. Nucl. Med.;* **20**: No. 7, 782-784(Jul 1979).

The compound ^{13}N L-glutamate was used to image an osteogenic sarcoma in a 9-year-old patient. Serial quantitative measurements of the amount of ^{13}N taken up by the primary tumor showed a decrease of 40% after 10 wk of chemotherapy. Blood-clearance data obtained from normal subjects indicate that more than 90% of the ^{13}N activity had left the blood before scanning of the tumor was begun. It appears that the ^{13}N label concentrated in the soft-tissue portion of this osteogenic sarcoma, whereas /sup 99m/Tc diphosphonate uptake was greatest in the regions where calcification was occurring.

4975 **Effects of Bouvardin (NSC 259968), a cyclic hexapeptide from Bouvardia ternifolia, on the progression capacity of cultured Chinese hamster cells.** Tobey, R.A.; Orlicky, D.J.; Deaven, L.L.; Rall, L.B.; Kissane, R.J. (Los Alamos Scientific Lab., NM). *Cancer Res.;* **38**: 4415-4421(Dec 1978).

Bouvardin (NSC 259968) was examined for effects on survival and cell cycle progression capacity in exponentially growing populations of line CHO Chinese hamster cells. Cells were slowed in their ability to traverse the cell cycle by concentrations of Bouvar-

din as low as 0.2 μg/ml, with complete inhibition observed at concentrations in excess of 1.0 μg/ml. Flow cytometric analysis indicated that there was very little rearrangement of cells around the cell cycle in treated cultures, suggesting that Bouvardin arrested cell progression uniformly throughout the entire cell cycle. Cells treated for prolonged periods of time with levels of Bouvardin inducing a total inhibition of cell division were highly resistant to drug-specific cytotoxicity (i.e., 58% of the cells continuously exposed to Bouvardin (2.0 μg/ml) for 62 h were capable of forming colonies). Cells entering mitosis either in the presence of the drug or following drug removal were free of chromosome aberrations. Asynchronous cells exposed to Bouvardin exhibited a terminal point of inhibition of traverse capacity situated 20 min prior to prophase. Concentrations of Bouvardin that affected cell cycle traverse capacity drastically reduced the incorporation of labeled leucine into acid-precipitable material, both in whole cells and in a cell-free, protein-synthesizing system. Consideration of both the incorporation data and the cell kinetic response and terminal point of action measurements led to the conclusion that Bouvardin was acting as a protein synthesis inhibitor. In view of these kinetic and cytotoxic properties, questions are raised concerning the value of Bouvardin as a chemotherapeutic agent.

4976 Antimatter-matter interactions. Positron-annihilation radiopharmaceuticals and the positron camera. Lambrecht, R.M. (Brookhaven National Lab., Upton, NY). pp 87-107 of Chemistry of radiopharmaceuticals. Heindel, N.D.; Burns, H.D.; Honda, T.; Brady, L.W. (eds.). New York, NY; Masson Publishing, USA, Inc. (1976).

An introductory review is given on the interdisciplinary overlap of the physical sciences in the applications of antimatter in radiopharmaceutical research and development. The characteristics of positrons, positron annihilation, positron cameras, and the positron-emitting nuclides becoming available for applications in noninvasive nuclear medicine are noted. The positron energy spectra of germanium 66, gallium 68, and bromine 76 are shown and discussed, as are the Doppler broadening of annihilation photons, the mean lifetime of positrons and positronium, and the positron camera together with its design, operation, and performance. 61 references. (JFP)

EXTERNAL RADIATION IN THERAPY

4977 (LA-UR—79-2905) **Utilization of pion production accelerators in biomedical applications.** Rosen, L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 40p. (CONF-791128—1). Dep. NTIS, PC A03/MF A01.

From 14. Japan conference on radioisotopes; Tokyo, Japan (20 Nov 1979).

A discussion is presented of biomedical applications of pion-producing accelerators in a number of areas, but with emphasis on pion therapy for treatment of solid, non-metastasized malignancies. The problem of cancer management is described from the standpoint of the physicist, magnitude of the problem, and its social and economic impact. Barriers to successful treatment are identified, mainly with regard to radiation therapy. The properties and characteristics of π mesons, first postulated on purely theoretical grounds by H. Yukawa are described. It is shown how they can be used to treat human cancer and why they appear to have dramatic advantages over conventional forms of radiation by virtue of the fact that they permit localization of energy deposition, preferentially, in the tumor volume. The Clinton P. Anderson Meson Physics Facility (LAMPF), and its operating characteristics, are briefly described, with emphasis on the biomedical channel. The design of a relatively inexpensive accelerator specifically for pion therapy is described as is also the status of clinical trials using the existing Clinton P. Anderson Meson Physics Facility. The advantages of proton over electron accelerator for the production of high quality, high intensity negative pion beams suitable for radiation therapy of malignancies is also addressed. Other current, medically related applications of LAMPF technology are also discussed.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 4479, 4943, 4963, 4969

4978 (LBL—9673) **Light induced surface potential changes in purple membranes and bacteriorhodopsin liposomes.** Carmeli, C.; Quintanilha, A.T.; Packer, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 14p. (CONF-790766—1). Dep. NTIS, PC A02/MF A01.

From International workshop on membrane bioenergetics; Detroit, MI, USA (5 Jul 1979).

Bacteriorhodopsin, the retinal containing protein from the purple membrane of Halobacterium halobium, is known to function as an electrogenic light activated proton pump. On illumination, the chromophore undergoes a photocycle in which its retinal Schiff base is reversibly protonated. The detailed molecular mechanism of H^+ translocation is not understood at present, but it may involve the Schiff base alone or other charge separation events, such as tyrosine deprotonation or charge displacement in tryptophan. These dissociation events could move along a sequence of amino acids thus providing a pathway for the protons across the purple membrane. Using continuous actinic light of moderate intensity and single turnover laser flashes we have studied the kinetics and stoichiometry of changes in surface charge that arise on purple membranes during proton release and binding.

4979 (UR—3490/LCP-16) **Enzymatic isolation of cells from bone: a critical evaluation.** Hefley, T.J. (Rochester Univ., NY (USA)). 1979. Contract EY-76-C-02-3490. 125p. Dep. NTIS, PC A06/MF A01.

Crude bacterial collagenase is essential to the enzymatic isolation of the cells from fetal rat calvaria. However, bacterial collagenase is the cause of the extensive damage and destruction observed in the isolated cells. In an attempt to standardize the digestion of fetal rat calvaria, bacterial collagenase was fractioned into its component enzymes and the participation of each of those enzymes in the digestion process was examined.

TRACER TECHNIQUES

4980 (COO—3419-20) **Studies on virus-induced cell fusion. Progress report, July 1, 1978-July 31, 1979.** Person, S. (Pennsylvania State Univ., University Park (USA). Dept. of Biochemistry and Biophysics). Aug 1979. Contract EY-76-S-02-3419. 17p. Dep. NTIS, PC A02/MF A01.

We have determined the extent of fusion in mixed Herpes Simplex Virus type 1 (HSV-1) cell populations. Labeled, sparse, infected cells were surrounded by unlabeled, excess, uninfected (or infected) cells to determine if fusion inhibition is active when present in the same cell as fusion factor, when present in cells that do not contain fusion factor, or in both situations. We found that wild type infected cells fuse to the same extent with each other as with uninfected cells. Therefore fusion inhibitor is active when present in the same cell as fusion factor. Other experiments indicate that the inhibition activity can also cause a small decrease of fusion when fusion factor and fusion inhibitor are present in different, but neighboring, cells. Marked variations are found in the capacity of different cell types, such as human embryonic lung (HEDL) and HEp-2 to support fusion by particular syn mutants. The difference in fusion capacity of the two cell types may be due to a difference in a cellular factor affecting the activity of viral, fusion-associated molecules, and not to cell surface differences of the uninfected cells. (PCS)

MORPHOLOGY

TRACER TECHNIQUES

4981 In situ root studies using neutron radiography. Willatt, S.T.; Struss, R.G.; Taylor, H.M. (Ames Lab., IA). *Agron. J.*; 70: 581-586(Jul 1978).

Most studies of plant roots growing in soil involve destructive sampling or involve estimates of root growth only at a soil-viewing surface interface where growth conditions are different from those in bulk soil. This research tested the feasibility of using preferential attenuation of thermal neutrons by roots to overcome these two disadvantages of current methods. Radiographs were obtained of soybean [Glycine max (L.) Merr.] and corn (Zea mays L.) roots growing through bulk samples of unsaturated soil. Plants were grown at 22 C in loamy sand soil wetted to 9% volumetric water content. The soil was contained in either 2.5- or 5.0-cm thick aluminum boxes. At irregular intervals, the sample containers were transferred into a 6° diverging 0.04eV (thermal) energy neutron beam obtained from the Ames Laboratory Research Reactor, US Energy Research and Development Administration, Iowa State University, Ames, Iowa. The samples were exposed to the neutron beam for 8 to 10 min. This exposure allowed about 5 x 10^9 neutrons/cm^2 to strike an indium collector plate attached to the rear of the container. After the collector plate was removed from the neutron beam, photographic film was attached to the collector plate for 1 1/2 hours; then the film was processed. The preferential neutron scattering by the roots allowed elongation rates of soybean radicles or seminal roots of corn to be determined easily through either 2.5- or 5-cm thick soil samples. Small lateral roots of either species were less clearly distinguishable and resolution must be improved before elongation rates can be measured for laterals with a diameter smaller than 0.33 mm. Plants were not harmed visibly by the thermal neutron fluxes used in these experiments.

PATHOLOGY

REFER ALSO TO CITATION(S) 4963, 4997

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 4944, 4945, 4948, 4950, 4960, 4967, 5013

4982 Reconstitution of the 20,000 dalton fragment of $Ca^{2+}+Mg^{2+}$-ATPase in phosphatidylcholine vesicles. Shamoo, A.E. (Univ. of Rochester, NY). pp 59-68 of Physical chemical aspects of cell surface events in cellular regulation. DeLisi, C.; Blumenthal, R. (eds.). New York, NY; Elsevier/North Holland (1979).

Evidence is presented that the 20,000 dalton fragment of $(Ca^{2+}+Mg^{2+})$-ATPase possesses Ca^{2+}-ionophorous properties in phosphatidylcholine vesicles as has been shown in black lipid membranes. Furthermore, it was shown that a 12,883 dalton cyanogen bromide fragment of the 20,000 dalton fragment possesses the Ca^{2+}-ionophorous characteristic.

4983 Interaction of glucocorticoids with macrophages. Werb, Z.; Foley, R.; Munck, A. (Univ. of Califorina, San Francisco). *J. Exp. Med.;* **147**: 1684-1694(1978).

The mononuclear phagocyte system plays a central role in mediating host responses in inflammation. Glucocorticoids have anti-inflammatory actions that may be of considerable importance in the therapeutic effects of these agents in chronic inflammation; it is possible that some of these effects are mediated through direct hormonal action on macrophages. Although the site of action of the glucocorticoids on macrophages has not been established, it has been shown that in many other glucocorticoid target systems the effects of glucocorticoids are mediated by specific macromolecular binding proteins, referred to as receptors. In this study we have established that monocytes and macophages contain saturable glucocorticoid-binding proteins, with specificity of binding for cortisol, corticosterone, and related synthetic steroids such as dexamethasone, and that they have dissociation constants for binding within physiological ranges.

4984 Ovulation in the PMSG-treated immature mouse: effect of dose, age, weight, puberty, season and strain (BALB/c, 129 and $C129F_1$ hybrid). Gates, A.H.; Bozarth, J.L. (Univ. of Rochester, NY). *Biol. Reprod.;* **18**: 497-505(1978).

Ovulation occurred in 99% of 22- to 27-day-old (BALB/c x 129) F_1 hybrid mice ($C129F_1$) 3 mornings after a single afternoon injection of pregnant mare's serum gonadotropin (PMSG; 2.5 IU). By contrast, inbred mice of the 2 parental strains ovulated less regularly and the optimal age for treatment with PMSG was several days later than that for the F_1 hybrids. The following findings were based on studies using $C129F_1$ hybrid mice. The average number of ova ovulated was highest (approximately 40 ova) in females 19 to 23 days old when treated with 2.5 IU PMSG. Doses of 1.25 IU PMSG and lower resulted in numbers of ova equal to, or fewer than, those at spontaneous ovulation. PMSG doses of 0.63 IU and lower, 5 IU and higher, were suboptimal in terms of frequency of mice ovulating. In mice over 4 weeks of age at treatment, the percentage which ovulated was significantly lower in postpubertal than in prepubertal mice. Other factors which were associated with a decreased incidence of PMSG-induced ovulation in immature mice were: loss of body weight and treatment during January (in contrast to February through October). It is proposed that PMSG-induced ovulation in the immature mouse (under readily controlled conditions, as described) is a particularly efficient and economical mammalian system either for studies of neurophysiological processes leading to ovulation or for bioassays of the ovulation-inhibitng effects of various pharmacological or environmental agents.

4985 Ionophorous properties of the 20,000-dalton fragment of $(Ca^{2+}+Mg^{2+})$-ATPase in phosphatidylcholine: cholesterol membranes. Shamoo, A.E. (Rochester Univ., New York, NY). *J. Membr. Biol.;* **43**: 227-242(1978).

The purified 20,000-dalton fragment of sarcoplasmic reticulum $(Ca^{2+}+Mg^{2+})$-ATPase has been shown to have Ca^{2+}-selective ionophoric activity. The Ca^{2+}-ionophoric fragment has been purified by either SDS-column chromatography or SDS-preparative gel electrophoresis. The Ca^{2+}-ionophoric fragment has been subjected to prolonged dialysis to insure the removal of bound SDS from the fragment. The selectivity sequence of this fragment in black lipid membranes (BLM) formed from either oxidized cholesterol or phosphatidylcholine/cholesterol is the same, P/sub Ba/ > P/sub Ca/ > P/sub Sr/ > P/sub Mg/ > P/sub Mn/. This selectivity sequence is the same as that for the intact $(Ca^{2+}+Mg^{2+})$-ATPase. Treatment of the fragment with cholate to absolutely insure the removal of bound SDS resulted in the fragment having a selectivity sequence as above except that P/sub Mn/ > P/sub Mg/. This and other data indicate that the 20,000-dalton fragment is the site containing the Ca^{2+}-ionophoric activity of the $(Ca^{2+}+Mg^{2+})$-ATPase.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 4947, 4966, 5003

4986 Energy-linked sulfate uptake by corn mitochondria via the phosphate transporter. Abou-Khalil, S.; Hanson, J.B. (Univ. of Illinois, Urbana). *Plant Physiol.;* **63**: 635-638(1979).

Corn shoot mitochondria possess an energy-linked transport system for sulfate uptake as demonstrated by osmotic swelling and $[^{35}S]SO_4^{2-}$ accumulation. Maximum uptake is secured in the presence of Mg^{2+} and oligomycin with sucrose for osmotic support. Neither phosphate nor dicarboxylate anions are required. When added simultaneously, millimolar concentrations of phosphate block $[^{35}S]SO_4^{2-}$ uptake after the initial minute. Mersalyl, N-ethylmaleimide, and 2,4-dinitrophenol are strong inhibitors of sulfate uptake; n-butylmalonate is a weak inhibitor. These inhibitors act in the same fashion on phosphate uptake. It is concluded that sulfate uptake in the absence of phosphate is by the phosphate transporter.

4987 Influx of pyrophosphate ions into calvaria in vitro. Neuman, M.W. (Univ. of Rochester, NY); Neuman, W.F.; Fleisch, H. Contrract EY-76-C-02-3490. *Calcif. Tissue Res.;* **25**: 19-21(1978).

The flux of ^{32}P-labeled inorganic pyrophosphate (PP/sub i/) into bone was studied in vitro using Ussing chamber techniques and calvaria from newborn rat pups. Because insignificant hydrolysis and backflux of PP/sub i/ took place under experimental conditions, it was possible to study the penetration of bone membranes by PP/sub i/ unambiguously. At physiological concentrations, the influx was found to be linearly concentration dependent and to follow first order kinetics, apparently a simple diffusion process. In magnitude, the intrinsic constant for influx was found to be approximately one-half that of inorganic phosphate ions under comparable conditions.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 4907

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 4202, 4916, 4968

4988 (BuM-RI—8376) Enhancing germination of Indian ricegrass seed used in stabilizing mineral wastes. Wullstein, L.H.; McDonald, W.R. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Metallurgy Research Center). 1979. 9p. US Dept. of the Interior, Pittsburgh, PA 15213.

Bureau of Mines research on methods for reclaiming land disturbed by the minerals sector of the economy has produced a specific procedure for effectively germinating seed of Indian ricegrass, a drought-tolerant plant valuable for reclaiming arid and semiarid sites. This report describes the procedure which consists of acid-treating the seed followed by temperature and light cycling treatments. Use of the procedure resulted in an average germination rate of 29 percent, ranging from 18 to 56 percent. Seed subjected to long cold treatment but with acid treatment yielded an average germination rate of 9.2 percent, ranging from 6.6 to 14.7 percent. Untreated seeds (controls) gave germination rates less than 0.1 percent.

4989 Effects of the antioxidant butylated hydroxytoluene (BHT) on mortality in BALB/c mice. Clapp, N.K.; Satterfield, L.C.; Bowles, N.D. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Gerontol.;* **34**: No. 4, 497-501(1979).

Butylated hydroxytoluene (BHT) was given in the feed to determine its effect on life span in genetically well-defined, barrier-derived BALB/c mice. Both sexes received 0.75% BHT for three different treatment periods: (A) 8 to 11 weeks of age; (B) for life, beginning at 11 weeks; (C) for life, beginning at 8 weeks of age. The control group (D) was untreated. All BHT treatment groups had mean survival times which exceeded that of controls. The order of survival was B > C > A > D (Males: 890, 832, 726, 684 days; Females: 875, 798, 759, 701 days). Most of the increases in mean survival time were related to a reduction in early deaths (350 to 600 days) in BHT-treated mice. The reason for the life-lengthening effect on BHT was not identified, but it may relate to alterations in specific disease incidences.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 5000

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

4990 Laser fluorescence bronchoscope for localization of occult lung tumors. Profio, A.E.; Doiron, D.R.; King, E.G. (Medical Imaging Science Group, University of Southern California School of Medicine). *Med. Phys.;* 6: No. 6, 523-525(Nov 1979).

A system for imaging occult bronchogenic carcinoma by the fluorescence of previously-injected, tumor-specific compound hematoporphyrin-derivative has been assembled and successfully used to locate a tumor 1 mm thick. The violet excitation source is a krypton ion laser coupled to fused quartz fiber light conductor. An electrostatic image intensifier attached to a standard flexible fiberoptic bronchoscope provides a bright image even at relatively low irradiance. A red secondary filter rejects most reflected background and autofluorescence. Sensitivity and contrast capability of the system should permit detection of a tumor less than 0.1 mm thick.

RADIATION EFFECTS ON BIOCHEMICALS

IN ANIMALS

4991 (CONF-790880—1) DNA synthesis inhibition in mammalian cells as a test for mutagenic carcinogens. Painter, R.B. (California Univ., San Francisco (USA). Lab. of Radiobiology). 1979. Contract EY-76-C-03-1012. 16p. Dep. NTIS, PC A02/MF A01.

From Workshop on short term tests for chemical carcinogens; Vancouver, Canada (22 Aug 1979).

Current models of DNA repair of biological damage are reviewed correlating the similarity between carcinogenesis and mutagenesis theories. (PCS)

RADIATION EFFECTS ON CELLS

4992 Synergistic biological effects of ultrasound and ionizing radiations evaluated in vitro. Toombs, B.D.; Kolodny, G.M.; Strandberg, M.W.P. (Massachusetts General Hospital, Boston). Contract DY-76-5-02-3335. *Radiology;* 132: No. 3, 731-734(Sep 1979).

The effects of diagnostic ultrasound on growing asynchronous cultures of Chinese hamster ovarian cells were evaluated, with particular attention to possible synergism with ionizing radiations. Measurements of cellular growth rate/survival and changes in morphology indicated that synergistic biological effects were absent.

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 4964, 4999

4993 Malignant transformation in cultured hamster embryo cells produced by x-rays, 430-keV monoenergetic neutrons, and heavy ions. Borek, C.; Hall, E.J.; Rossi, H.H. (Columbia Univ., New York, NY). *Cancer Res.;* 38: 2997-3005(Sep 1978).

Short-term cultures of golden hamster embryo cells were irradiated with doses of x-rays from 1 to 600 rads or 430-keV monoenergetic neutrons from 0.1 to 150 rads. Both cell killing and oncogenic transformation were scored. The transformation frequency per surviving cell for neutrons reaches a higher maximum value than that for x-rays. When the data are expressed as the number of transformations per initial cells at risk, the two dose-response curves rise to essentially the same peak value. It follows that the maximum carcinogenic potential of the two radiations is the same. From the data, the relative biological effectiveness (relative to x-rays, the ratio of doses (D) of the two types of radiation required to produce the same biological effect, i.e., D x-ray/D neutron) of neutrons as a function of dose may be calculated for both cell killing and transformation. The neutron relative biological effectiveness for transformation was generally similar to that for cell killing. Studies of the biological properties of the malignant transformed cells indicated no qualitative difference in those transformed by neutrons compared with those transformed by x-rays. One experiment was performed in which cells were exposed to argon ions (429 MeV/ atomic mass unit) at the BEVALAC (Lawrence Berkeley Laboratory, Berkeley, Calif.). For a given dose, argon ions are much more effective in producing transformations than are x-rays and are in fact similar in effectiveness to 430-keV neutrons.

INTERNAL SOURCE

REFER ALSO TO CITATION(S) 4998

4994 Indium-111-labeled human polymorphonuclear leukocytes: viability, random migration, chemotaxis, bactericidal capacity, and ultrastructure. Zakhireh, B.; Thakur, M.L.; Malech, H.L.; Cohen, M.S.; Gottschalk, A.; Root, R.K. (Yale Univ. School of Medicine, New Haven, CT). Contract EY-76-S/02/4078. *J. Nucl. Med.;* 20: No. 7, 741-747(Jul 1979).

Human polymorphonuclear leukocytes (PMNs) were labeled with indium-III (In-III) oxine in ethanol, and the effects of the labeling procedure, radioactivity, and concentrations of oxine and ethanol on PMN function and structure were studied in vitro. The standard labeling procedure did not alter the viability, random migration, chemotaxis, bactericidal capacity, or the ultrastructure of PMNs. Exposure to higher doses of radioactivity, or to higher concentrations of ethanol, had no appreciable effects on random migration and chemotaxis of PMNs. A dose-dependent reduction in their random migration and chemotaxis was observed when higher concentrations of oxine were used. These results indicate that In-III-labeled PMNs are structurally intact and have normal in vitro locomotion and bactericidal activity. Indium-III-labeled PMNs should be suitable for studying the kinetics and distribution of these cells in health and disease.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 5020

4995 (LA-UR—79-2802) What has happened to the survivors of the early Los Alamos nuclear accidents. Hempelman, L.H.; Lushbaugh, C.C.; Voelz, G.L. (Los Alamos Scientific Lab., NM (USA); Oak Ridge Associated Universities, Inc., TN (USA)). 1979. Contract W-7405-ENG-36. 33p. (CONF-791085—1). Dep. NTIS, PC A03/MF A01.

From Radiation accident preparedness conference; Oak Ridge, TN, USA (19 Oct 1979).

Two nuclear accidents involving a plutonium sphere just subcritical in size occurred at the Los Alamos Laboratory, LA-1 in 1945 and LA-2 in 1946. Because remote control devices were deemed unreliable at the time, the tamper material (tungsten carbide bricks in LA-1 and beryllium hemispheres in LA-2) was added by hand with the operator standing next to the assembly. In each case the critical size of the assembly was accidentally exceeded and the resultant exponentially increasing chain reaction emitted a burst of neutrons and gamma rays. Ten persons were exposed to the radiation bursts which were largely composed of neutrons. The doses ranged from fatal in the case of the two operators, to small in the case of some survivors. The two operators died within weeks as a result of acute radiation injury. Only six of the eight survivors were available for follow-up study ten or more years after the accident. Four of these six survivors are now dead, but the two living survivors are in excellent health with no clinical or laboratory evidence of late radiation injury. Two of the deceased died of acute myelogenous leukemia, another died at age 83 of refractory anemia, and the fourth of myocardial infarction. The heart attack could have been precipitated by the myxedema assumed to have been the result of the radiation exposure.

4996 (PNL-SA—7000) Assessment of risks from occupational exposure to ionizing radiation. Gilbert, E.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 18p. Dep. NTIS, PC A02/MF A01.

The assessment of health effects from occupational exposure to radiation presents a variety of problems resulting from the time dependent nature of the exposure data, the more favorable health frequently experienced by working populations, and limits imposed by the size of the populations and the magnitudes of the exposures received. A proportional hazards model is used to derive tests for determining if statistically significant effects are present and is also considered for point estimation. Because effects of the size expected from current estimates are unlikely to be detected in occupationally exposed groups, methods of calculating upper confidence limits are considered. Data from the Hanford plant are used to illustrate many of the problems and procedures.

VERTEBRATES

4997 Renal effects of renal x irradiation and induced autoallergic glomerulonephritis. Rappaport, D.S.; Casarett, G.W. (Univ. of Rochester School of Medicine and Dentistry, NY). Contract UR-3490-1371. *Radiat. Res.;* 79: No. 3, 492-519(Sep 1979).

This study was conducted to determine what influence a single large x-ray exposure of kidney has on the development and course of an experimental autoallergic glomerulonephritis (EAG) in rats. EAG was induced in female Sprague-Dawley rats by immunization with Bordetella pertussis vaccine and homogenate of homolo-

gous kidney tissue and Freund's complete adjuvant. Progressive arteriolonephrosclerosis (ANS) was observed in right (irradiated) kidneys following unilateral renal irradiation (1500 rad). Rats were either immunized, sham-immunized, irradiated, sham-irradiated, or both immunized and irradiated. Light and immunofluorescent microscopic observation, urine protein content, and kidney weights were evaluated. In immunized-irradiated animals the effects of irradiation and immunization were largely additive. Immunization did not considerably influence the development and course of ANS and irradiation did not considerably influence the development and course of EAG.

4998 Oncogenic transformation in vitro by the hypoxic cell sensitizer Misonidazole. Miller, R.C.; Hall, E.J. (Columbia Univ., New York, NY). *Br. J. Cancer;* **38**: 411-417(1978).

The hypoxic cell sensitizer Misonidazole (Ro-07-0582) induces oncogenic transformations in the C3H/10T 1/2 mouse embryo cell line cultured in vitro. A drug concentration of 0.4 mM applied to aerated cells for 3 or 6 days results in a transformation rate comparable to that observed following an x-ray dose of 1 Gray. A higher drug concentration of 6.0 mM is equivalent to 4 Gy. The combination of Misonidazole and x-rays produces a significant increase in the frequency of transformation over either drug or radiation alone, but the data are equivocal on the question of additivity vs synergism.

4999 Improved device for animal immobilization during tumor irradiation. Archuleta, R.F. (Los Alamos Scientific Lab., NM). *Lab. Anim. Sci.;* **27**: No. 5, 703-704(Oct 1977).

A special apparatus developed for animal immobilization during tumor irradiation is discussed.

INVERTEBRATES

5000 Boll weevil: experimental sterilization of large numbers by fractionated irradiation. Haynes, J.W. (Dept. of Agriculture, Mississippi State, MS); Wright, J.E.; Davich, T.B.; Roberson, J.; Griffin, J.G.; Darden, E. *J. Econ. Entomol.;* **71**: No. 6, 943-946(Dec 1978).

Boll weevils, Anthonomus grandis grandis Boheman, 9 days after egg implantation in the larval diet were transported from the Boll Weevil Research Laboratory, Mississippi State, MS, to the Comparative Animal Research Laboratory, Oak Ridge, TN, and irradiated with 6.9 krad (test 1) or 7.2 krad (test 2) of ^{60}Co gamma rays delivered in 25 equal doses over 100 h. In test 1, from 600 individual pairs of T (treated) males x N (normal) females, only 114 eggs hatched from a sample of 950 eggs, and 47 adults emerged from a sample of 1042 eggs. Also, from 600 pairs of T females x N males, 6 eggs hatched of a sample of 6 eggs and 12 adults emerged from a sample of 20 eggs. In test 2, from 700 individual pairs of T males x N females, 54 eggs hatched from a sample of 1510, and 10 adults emerged from a sample of 1703 eggs. Also, in T females x N males matings, 1 egg hatched of a sample of 3, and no adults emerged from a sample of 4. Transportation and handling in the 2nd test reduced adult emergence an avg of 49%. Thus the 2 replicates in test 2 resulted in 3.4×10^5 and 4.3×10^5 irradiated weevils emerging/day for 7 days. Bacterial contamination of weevils was low.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

5001 (LA-UR—79-2684) **Statistical analysis of a LASL study of plutonium in US autopsy tissue.** Fox, T.; Tietjen, G.L.; McInroy, J.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 49p. (CONF-791077—2). Dep. NTIS, PC A03/MF A01.

From Workshop on measurement and interpretation of actinide accumulation by man; Snowbird, UT, USA (14 Oct 1979).

The Autopsy Tissue Program was begun in 1960. To date, tissues on 900 or more persons in 7 geographic regions have been collected and analyzed for plutonium content. The tissues generally consist of lung, liver, kidney, lymph, bone, and gonadal tissues for each individual. The original objective of the program was to determine the level of plutonium in human tissues due solely to fallout from weapons testing. The baseline thus established was to be used to evaluate future changes. From the first, this program was beset with chemical and statistical difficulties. Many factors whose effects were not recognized and not planned for were found later to be important. Privacy and ethical considerations hindered the gathering of adequate data. Since the chemists were looking for amounts of plutonium very close to background, possible contamination was a very real problem. Widely used chemical techniques introduced a host of statistical problems. The difficulties encountered touch on areas common to large data sets, unusual outlier detection methods minimum detection limits, problems with aliquot sizes, and time-trends in the data. The conclusions point out areas to which the biologists will have to devote much more careful attention than was believed.

5002 (ORO—1643-136) **Studies in iodine metabolism.** Middlesworth, L.V. (Tennessee Univ., Memphis (USA). Dept. of Physiology and Biophysics). 1979. Contract EY-76-S-05-1643. 69p. Dep. NTIS, PC A04/MF A01.

The major contributions of this research are shown by diagrams. Each major development has led to another and their interrelationships are discussed.

ANIMALS

REFER ALSO TO CITATION(S) 4933

5003 Method of removing actinide elements from mammalian tissue. Schubert, J. (to Dept. of Energy). US Patent Application 942,229. 14 Sep 1978. 15p.

According to the present invention, a solution of polyaminopolycarboxylic acid such as EDTA or DTPA and a bidentate secondary ligand such as salicylic acid or catechol or derivatives thereof containing electron withdrawing groups are introduced into the body and bloodstream whereby the actinide elements are solubilized by formation of a mixed ligand complex which is eliminated from the body by normal excretion.

5004 Pu and Am decorporation in beagles: effects of magnitude of initial Ca-DTPA injection upon chelation efficacy. Lloyd, R.D.; Jones, C.W.; Taylor, G.N.; Mays, C.W.; Atherton, D.R. (Univ. of Utah Medical Center, Salt Lake City). Contract EY-76-C-02-0119. *Radiat. Res.;* **79**: No. 3, 630-634(Sep 1979).

To investigate the effects of magnitude of initial DTPA injection upon chelation efficacy, five young adult beagles were each given an intravenous injection of $^{237+239}$Pu(IV) citrate + ^{241}Am(III) citrate, followed by a single intravenous injection of Ca-DTPA 0.5 hr later. Amounts of this chelating agent administered were 3, 10, 30, 100, and 300 μmole Ca-DTPA/kg body mass. Animals were sacrificed 7 days later. Total-body retention of both plutonium and americium was influenced strongly by the amount of DTPA administered, although the removal of Pu by DTPA was less pronounced than that of Am; and in the range of 30 μmole/kg, an increase of DTPA administration by a factor of 2 resulted in only a 25% decrease in residual body content. Plutonium retention at 7 days was reduced from about 77% in the dog given 3 μmole/kg to 14% in the animal injected with 300 μmole/kg. Corresponding values for americium were 40 and 9%. Also, liver content of both Pu and Am was reduced significantly by larger amounts of administered DTPA, decreasing from 18 to 2% for Pu with increasing levels of DTPA, and from 21 to 1% for Am. If there is a level of Ca-DTPA administration at 30 min after injection in a beagle at which no additional chelation of Pu or Am is produced with increasing dosage, it is greater than 300 μmole/kg. In a 70-kg human, this would be equivalent to the injection of 10 g Ca-DTPA.

VERTEBRATES

REFER ALSO TO CITATION(S) 4926

CHEMICALS METABOLISM AND TOXICITY

5005 (AD-A—064196) **Biological effects of oil pollution - a comprehensive bibliography with abstracts. Final report.** Light, M.; Lanier, J.J. (Coast Guard Research and Development Center, Groton, CT (USA)). Oct 1978. 648p. NTIS PC A99/MF A01.

This bibliography is a compilation of abstracts of literature on the biological effects of oil pollution. Comprehensive coverage is provided on oil spill incidents, toxicity, tainting, behavioral effects, physiological effects, biodegradation, effects of cleaning agents, analyses for petroleum hydrocarbons in tissues, and other related topics. Over 1200 references with abstracts are included. Rapid access to and cross-referencing of any given abstract is provided by use of a permuted index that lists alphabetically the keywords and corresponding citation number assigned to each abstract. The bibliography should be a valuable reference tool for oil pollution researchers, environmental scientists, federal, state and municipal planners, administrators, and other decision makers.

CELLS

REFER ALSO TO CITATION(S) 4941, 4946, 4991

5006 (LA-UR—79-2737) **Flow cytometric analysis of respiratory tract cells exposed to oil shale and silica particulates.** Steinkamp, J.A.; Wilson, J.S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 19p. (CONF-791002—1). Dep. NTIS, PC A02/MF A01.

From 19. annual Hanford life sciences symposium; Richland, WA, USA (22 Oct 1979).

Flow cytometric techniques were used to measure the cytological and biochemical damage to respiratory tract cells in animals exposed to particulates. Hamsters were exposed to raw and spent oil shale particulates and silica by intratracheal instillation. Exfoliated lung cells were obtained by sacrificing the animals and lavaging the respiratory tract posterior to the trachea with saline. Cell samples were fixed in ethanol and stained with mithramycin for fluorescence analysis of DNA content. DNA content distributions from hamsters exposed to spent oil shale and silica particulates showed atypical changes 28 to 35 days later. Cell counts and total numbers of macrophages, leukocytes, and epithelial cells in the lavage fluid also showed marked changes related to time after exposure.

MICROORGANISMS

REFER ALSO TO CITATION(S) 5009, 5011

5007 (SNV-PM—1203) **Effects of heavy metal pollution on decomposition in forest soils. VI. Metals and sulfuric acid.** Tyler, F.; Westman, L. (Statens Naturvaardsverk, Stockholm (Sweden)). May 1979. 36p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The aims of this study are to determine to what extent soil biological processes are influenced in the coastal region of Vaesterbotten, northern Sweden, by deposition of metals and acid from a large smelter, Roennskaersverken. Elevated levels of several heavy metals in the topsoil of forested areas are measurable at least 70 to 80 km from the main source. The pollution has a measurable influence on important biological reactions in conifer forest soil over an area of at least 2500 to 4000 km^2, particularly evident northwards and southwards from Roennskaersverken. According to statistical evidence, pH and heavy metal contents of the forest mor account for a considerable part of the variability in soil respiration rate and phosphatase activity. Of the main polluting metals (Cd, Cu, Zn, Pb, As) cadmium and copper have the highest simple correlation coefficients with the soil biological variables. However, soil pH contributes roughly as much as all the metals together to account for the biological variability of the soil reactions studied, according to stepwise regression analysis. The variation in pH will partly be explained by natural differences between sites and partly by soil acidification due to deposition of acid pollutants. The mean level of pH-KCl is at least 0.2 units lower than in comparable sites of central Sweden.

PLANTS

REFER ALSO TO CITATION(S) 4937, 4970, 5011

5008 (AD-A—063914) **Phytotoxic hazard of air pollution associated with munition production. Final report, 1 February 1977-31 March 1978.** Thompson, C.R.; Kats, G. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Aug 1978. Contract DAMD17-77-C-7015. 103p. NTIS PC A06/MF A01.

The phytotoxicity of nitrotoluenes (NT), tetranitromethane (TNM), nitromethane (NM), methyl nitrate (MN), acetic acid (HAC) and SO_2 was tested on seven species of plants: wheat, alfalfa, soybean, tobacco, corn, white oak, and scotch pine. These species were fumigated for 120 min after which effects were observed for several hours or days. The plant species were grown in large pots in air conditioned greenhouses prior to and after fumigation. Low concern concentrations were specified by the Government as criteria for the intensity of testing. Based on low concern concentrations, wheat, alfalfa, tobacco, soybean and corn were injured sufficiently with TNM or HAC to warrant further studies. White oak and scotch pine did not exhibit severe enough injury to warrant further study. Moreover, minimal or no injury was observed on any of the plant species tested with NM, NT, or MN. An index of toxicity, EC_{40}, was devised which represented the dosage of phytotoxicant which caused injury to 50% of all the leaves on an exposed plant population. The EC_{50}'s of TNM were as follows: wheat 0.68, alfalfa 0.93, tobacco 6.1, soybean 0.69, and corn 2.1 mg/cu m; SO_2 on wheat 3.35, alfalfa 6.8, tobacco 18.6, soybean 6.8, and corn 21.4 mg/cu m; HAC on wheat 23.3, alfalfa 7.8, tobacco 41.2, soybean 20.1, and corn 50.1 mg/cu m. Tetranitsomethane is, in fact, one of the most phytotoxic compounds which has been tested on plants.

INVERTEBRATES

REFER ALSO TO CITATION(S) 5007, 5011

5009 (AD-A—064184) **Inquiry into the suitability of protozoa as biological indicators of oil pollution. Final report.** Lanier, J.J.; Light, M. (Coast Guard Research and Development Center, Groton, CT (USA)). Jun 1978. 53p. NTIS PC A04/MF A01.

An inquiry was made into the suitability of protozoa as bioindicators of oil pollution. Oil uptake rates and oil toxicity were measured for the marine ciliate protozoan Euplotes diadaleos. Euplotes ingest oil at a rate of approximately 1 ng/min over the first three hours of exposure to an emulsion of oil in water. The 90hr LC50 of the solubilized fraction of crude oil is 1.7 ppm. Toxicity is directly correlated with the log of the concentration of oil with one interesting exception: the population of Euplotes increases dramatically at 8 ppm. Field experiments using artificial substrates in oiled ponds indicated that: (1) oil descends through the water column as droplets associated with detritus; (2) the rate of descent is directly correlated with the salinity of the water, and (3) the interaction of oil with microfaunal communities is complex. The biological parameters of population, species number, and community diversity index generally exceeded pre-spill levels after three weeks. In one substrate, however, the values of these parameters were reduced to zero. The data suggest an interaction between a stimulating effect of oil as seen with Euplotes at 8 ppm, and a toxicity of oil that, in time, can overcome microfaunal defense mechanisms.

5010 **Bioaccumulation potential of polycyclic aromatic hydrocarbons in Daphnia pulex.** Southworth, G.R.; Beauchamp, J.J.; Schmieder, P.K. (Oak Ridge National Lab., TN). *Water Res.;* **12**: 973-977(1978).

The bioaccumulation potentials by aquatic biota from aqueous solution were determined for seven polycyclic aromatic hydrocarbons (PAH). The PAH were tested using Daphnia pulex and consisted of the following compounds: naphthalene, anthracene, phenanthrene, pyrene, 9-methylanthracene, benz(a)anthracene and perylene. Bioaccumulation kinetics were described as a first order approach to equilibrium in a two-compartment model (water and Daphnia), using a two-stage technique to estimate uptake and elimination rates, while accounting for decreasing aqueous concentrations. Estimates of equilibrium concentration factors were obtained by two methods: (1) evaluating the kinetic model as t tends to infinity and (2) direct measurement of concentration factor at t = 24h. Estimations of equilibrium concentration factors obtained by the two methods were in good agreement, and increased dramatically with increasing molecular weight within the series of compounds. The calculated n-octanol-water partition coefficient was shown to be a good predictor of bioaccumulation potential of PAH in Daphnia. PAH were concentrated from a high of about 10,000-fold for benz(a)anthracene to a low of about 100-fold for naphthalene.

VERTEBRATES

REFER ALSO TO CITATION(S) 4929, 4961, 4991

5011 (NTIS/PS—79/0584) **The biological effects of oil spills (citations from the American Petroleum Institute data base). Report for 1975-Apr 79.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 182p. NTIS PC N01/MF N01.

The selected abstracts cover aspects of the biological and ecological effects of oil spills in salt and fresh water. The effects on microorganisms, plants, and animals are studied, along with research on the residues and metabolic products of various oil components. (Contains 176 abstracts)

5012 **Correlation of fluorescence intensity and carcinogenic potency of synthetic and natural petroleums in mouse skin.** Holland, J.M.; Whitaker, M.S.; Wesley, J.W. (Oak Ridge National Lab., TN). *Am. Ind. Hyg. Assoc. J.;* **40**: 496-503(Jun 1979).

After standardized topical exposure of mouse skin to synthetic and natural petroleums, the penetration and persistence of the fluorescent components have been quantitated. Carcinogenicity of the same materials was determined by repeated skin application followed by a period without treatment to allow expression of malignantly transformed epidermal cells. No simple correlation was found for the materials between total specific fluorescence in either tissue or the test tube and their observed capacity to elicit skin necrosis or malignancy. The number of test materials was insufficient to allow generalization; however, the results do suggest that before fluorescence can be effectively employed as a tool for assessing potential occupational exposure to complex hydrocarbon mixtures, considerable refinement of the methodology will be required.

5013 **Removal of plutonium from hepatic tissue.** Lindenbaum, A.; Rosenthal, M.W. (to Dept. of Energy). US Patent 4,143,131. 6 Mar 1979. Filed date 29 Mar 1974. 6p.

PAT-APPL-546,851.

A method is provided for removing plutonium from hepatic tissues by introducing into the body and blood stream a solution of the complexing agent DTPA and an adjunct thereto. The adjunct material induces aberrations in the hepatic tissue cells and removes intracellularly deposited plutonium which is normally unavailable for complexation with the DTPA. Once the intracellularly deposited plutonium has been removed from the cell by action of the adjunct

material, it can be complexed with the DTPA present in the blood stream and subsequently removed from the body by normal excretory processes.

5014 Methylated mercury in brook trout (Salvelinus fontinalis): absence of an in vivo methylating process. Huckabee, J.W.; Janzen, S.A.; Blaylock, B.G.; Talmi, Y.; Beauchamp, J.J. (Oak Ridge National Lab., TN). *Trans. Am. Fish. Soc.;* 107: No. 6, 848-852(Nov 1978).

The possibility of in vivo conversion of inorganic mercury to MeHg in brook trout (Salvelinus fontinalis) was tested by chronically exposing fish to mercury (from $Hg(NO_3)_2$) at a concentration of 1 ng/ml, for 56 days, and then maintaining them at background levels for 294 days. The concentrations of inorganic and methylated mercury (MeHg) in several organs of control and test fish were periodically measured over this 50-wk period. The inorganic mercury levels in test fish increased rapidly during exposure. The MeHg concentrations in both control and test fish increased slowly and at the same rate, with final 350-day concentrations comparable to levels found in wild brook trout from an uncontaminated area. This information indicates that fish do not methylate inorganic mercury in vivo, and that approximately one-half of the MeHg body burdens in the fish was acquired via the food.

5015 Effects of carcinogen dose on the characteristic of the tracheal tumor response induced by N-nitroso-N-methylurea in hamsters. Yarita, T.; Nettesheim, P. (Oak Ridge National Lab., TN). *Int. J. Cancer;* 22: 298-303(1978).

Tracheal tumors were induced by repeated intratracheal exposures to the carcinogen N-nitroso-N-methylurea (NMU), using a catheter system previously described. Carcinogen concentrations of 0.25, 0.50, and 1.0% were employed in 20 or 30 twice-weekly exposures. Most of the tumors developed in the mid-portion of the tracheas. Virtually all tumors developed after the end of the 10 to 15-week exposure period. Tumor incidence ranged from 20 to 94% with mean tumor induction times of 13 to 46% weeks, depending on NMU concentration and frequency of exposue (i.e. dose). At lower doses, mostly non-invasive tumors were induced; at higher doses, mostly invasive carcinomas of various histological types (epidermoid, adeno-, epidermoid-adeno, and anaplastic large- and small- cell carcinomas) were induced. Adenocarcinomas were most frequent at low NMU concentrations. The possible mechanisms of the carcinogen dose effects are discussed.

5016 Ethanol-increased exhalation of mercury in mice. Dunn, J.D. (Univ. of Rochester, NY); Clarkson, T.W.; Magos, L. *Br. J. Ind. Med.;* 35: 241-244(1978).

CBA/J mice injected three days beforehand with $^{203}HgCl_2$ were given ethanol or water by gavage and placed in a chamber designed to collect exhaled mercury. Ethanol treatment led to an eight-fold increase of counts accumulated on a filter over a four-hour period, compared with water-treated mice. The mercury-collection apparatus tested for extracorporeal contribution of volatilized mercury indicated that the counts originated from the air exhaled by the mice.

MAN

REFER ALSO TO CITATION(S) 4907, 4908

5017 (PB—295913) **Plan for air pollution research in the Texas Gulf Coast Area. Volume II. Plan for health effects studies. Final report.** Johnson, D.E.; Prevost, R.J. (Radian Corp., Austin, TX (USA)). Apr 1979. Contract EPA-68-02-2955. 61p. NTIS PC A04/MF A01.

In the study reported here, a plan for air pollution research was developed for the Texas Gulf Coast Area. This report is Volume II of a five part series of reports documenting that plan and is specifically directed at presenting a plan for health effects studies. Available aerometric, health effects, demographic, and meteorologic data as well as other inputs resulting from public meetings were reviewed and considered in development of the plan. Documentation begins with a general assessment of area populations, air quality, and relevant health effects. Questions are addressed which must be answered in accomplishing a plan for health effects studies. The plan begins with detailed discussion of the general research needs of the area regarding health effects and presents a set of hypotheses which need to be addressed with specific studies. The plan culminates with description of twelve types of studies considered to be most useful in providing definitive answers. Relative priorities, time sequencing, and rough cost estimates are provided with the study descriptions.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 4489, 4490, 4491, 4492, 4493, 4494, 4495, 4941, 4952

5018 (NTIS/PS—79/0432) **Biological effects of microwaves. Vol. 1. 1964-1977 (a bibliography with abstracts). Report for 1964-1977.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). May 1979. 212p. NTIS PC N01/MF N01.

The selected abstracts cover the biological effects on man and animals from exposure to microwaves. In addition to dosages and tolerances, regulations, and standards are included. (This updated bibliography contains 204 abstracts, none of which are new entries to the previous edition.)

5019 (NTIS/PS—79/0433) **Biological effects of microwaves. Volume 2. 1978-may, 1979 (a bibliography with abstracts). Report for 1978-May 1979.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). May 1979. 51p. NTIS PC N01/MF N01.

The selected abstracts cover the biological effects on man and animals from exposure to microwaves. In addition to dosages and tolerances, regulations, and standards are included. (This bibliography contains 45 abstracts, 29 of which are new entries to the previous edition.)

HEALTH AND SAFETY

5020 (UCRL—50007-79-1) **Hazards control progress report No. 57, October-March 1979.** Griffith, R.V. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

Progress is reported in research on the following subjects: gas chromatographic/mass spectrometric analysis of thermal degradation products from wood and composite burns; corrosion in the experimental ducting of the fire test cell; on-line x-ray fluorescence analysis of transition metals in waste water: Phase II; fire environmental tests for self-contained breathing apparatus; developments in neutron spectrometry; and, intermediate energy x-ray spectra for general shielding calculations. (JGB)

5021 Respirator protection factors: Part I - Development of an anthropometric test panel. Hack, A.L.; McConville, J.T. (Los Alamos Scientific Lab., NM). *Am. Ind. Hyg. Assoc. J.;* 39: 970-975(Dec 1978).

Respirators are currently approved by testing them on a number of subjects without specifying facial sizes. Anthropometrically designed test panels were developed that represent the majority of the working population in terms of relevant facial measurements.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 4016

GEOPHYSICS

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 4922, 5024

VOLCANOLOGY

5022 (LA-UR—79-2795) **Mechanism of magma mixing at Glass Mountain, Medicine Lake Highland Volcano, California.** Eichelberger, J.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 21p. (CONF-791080—1). Dep. NTIS, PC A02/MF A01.

From Oregon Department of Geology and Mineral Industries Volcanology symposium; Bend, OR, USA (15 Oct 1979).

Mixing of basaltic and rhyolitic magmas at Glass Mountain appears to have been driven by vesiculation of basaltic magma as it intruded a rhyolitic magma chamber. Rapid cooling of basaltic magma formed a mafic foam which floated and became concentrated at the roof of the chamber. Foam-rich lava emerged first during the eruption, and became the hybrid dacite of the distal end of the flow.

The chamber is probably a relatively large-volume, long-lived feature, lying within 10 km of the surface beneath the caldera. This mechanism of mixing between silicic magma stored in a crustal chamber and basaltic magma feeding the chamber is controlled by initial water content of basaltic magma, and implies that dry basaltic magma would remain at the base of the chamber. The eastward change from andesitic to bimodal volcanism in this portion of the Cascade Range may be due to an eastward decrease in water content of parental basaltic magmas. 6 figures, 1 table.

GEOPHYSICAL SURVEY METHODS

5023 (BMFT-FB-T—79-56) **Development of a floating point convolver (array processor) and integration into a computer system for the processing of seismic data.** Meinicke, G.; Loeb, E.; M'Seddi, A. (Prakla-Seismos G.m.b.H., Hannover (Germany, F.R.)). Nov 1979. 83p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

The development of a floating point convolver and its integration into a computer system for the processing of seismic data inevitably resulted in the development of an efficient Array Processor System (APS). The total project of a small efficient seismic processing system SSP-11 A with the host computer PDP 11/45 with integrated APS can be considered as a successful one. Seismic processes are carried out in floating point format by the APS and, thus, the basis for the Real Amplitude Processing is provided. Moreover, the efficiency of the system SSP-11 A, in the relation to SSP-11, can be doubled, with regard to the throughput of seismic data. Thus, in the new system SSP-11 A capacity for more sophisticated seismic programs is available. For decentralized operation the SSP-11 A is, as a minicomputer system, a real economical alternative to large computer systems. 7 figures.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

5024 (AD-A—062433) **Seismic liquefaction potential. Technical note, October 1977-March 1978.** Ferritto, J.M.; Forrest, J.B. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Sep 1978. 192p. NTIS PC A09/MF A01.

This report presents a summary of the factors causing seismically induced soil liquefaction. The report presents the current procedures in use to compute the liquefaction potential of a site. Risk analysis procedures are presented to better estimate the probability of liquefaction.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

5025 **Solar modulation of cosmic ray electrons 1969—1977.** Evenson, P.; Caldwell, J.; Jordan, S.; Meyer, P. (Gulf Research Development Company). *J. Geophys. Res.;* **84**: No. A9, 5361-5365(1 Sep 1979).

We discuss the gross morphological features of the cosmic ray electron spectrum from 200 MeV to 6 GeV as measured in eight of the nine years 1969—1977. We find no evidence that the solar magnetic field polarity change of 1970—1971 affected the relative modulation of electrons and protons. However, previously noted problems in explaining the variation of both the electron and proton modulation by one model can at least qualitatively be understood by allowing simultaneous variations in the diffusion coefficient and the boundary of the modulation region in a spherically symmetric solution of the Fokker-Planck equation. This model also predicts a change in the radial gradient of protons from 1973 to 1974.

STARS

REFER ALSO TO CITATION(S) 5101

5026 (LA-UR—79-2785) **Pulsation of high luminosity helium stars.** King, D.S.; Wheeler, J.C.; Cox, J.P.; Cox, A.N.; Hodson, S.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790364—4). Dep. NTIS, PC A02/MF A01.

From Nonradial and nonlinear stellar pulsation workshop; Tucson, AZ, USA (12 Mar 1979).

Preliminary calculations are made on a systematic restudy of the linear and nonlinear pulsations of helium stars allowing for more recent and higher estimates of the effective temperature and for the high carbon abundance. Linear and nonlinear models are used. Results show qualitative agreement with earlier ones, models with sufficiently large L/M have a very hot blue edge for their instability strip, very large L/M values lead to dynamically unstable models which would appear to eject mass and therefore may not be realistic models for the pulsating RCrB stars, for the sequence studied a reasonable mass could be $\geqq$ 1.5 Msub solar. 12 references. (JFP)

5027 **Neutrino emissivities of neutron stars.** Friman, B.L.; Maxwell, O.V. (NORDITA, Copenhagen, Denmark). EY-76-S-02-3001. *Astrophys. J.;* **232**: No. 2, 541-557(1 Sep 1979).

Neutrino emissivities from the modified Urca process, considered previously by Bahcall and Wolf, and neutrino pair bremsstrahlung from nucleon-nucleon scattering, considered previously by Flowers et al., are recalculated using a nucleon-nucleon interaction that consists of a long-range, one-pion-exchange tensor part and a short-range part parametrized with nuclear Fermi liquid (Landau) parameters. Effects of short-range correlations on the tensor part are approximated through insertion of a cutoff in the one-pion exchange potential. The resulting emissivities differ dramatically from previous calculations: the emissivities from the Urca process and the neutron-neutron neutrino pair bremsstrahlung exceed the results of Bahcall and Wolf and Flowers et al., respectively, by an order of magnitude. It is argued that these results are due to the one-pion-exchange tensor force in the nucleon-nucleon interaction used here. The neutrino mean free path arising from a reaction related to the Urca process is also calculated, and the influence of finite neutrino mean free path and nucleon superfluidity on neutrino emissivities is briefly discussed.

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 5030

5028 **Core electron temperature profile between 0.5 and 1.0 AU in the steady-state high speed solar wind.** Feldman, W.C.; Asbridge, J.R.; Bame, S.J.; Gosling, J.T.; Lemons, D.S. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **84**: No. A8, 4463-4467(1 Aug 1979).

The radial dependence of the core electron temperature in the steady-state high speed solar wind between 0.5 and 1.0 AU is measured using Mariner 10 and Imp 6, 7, and 8 instrumentation. The observed temperature profile is best characterized by two separate power-law functions which apply in the radial ranges between 0.47 and 0.62 AU and between 0.62 and 1.0 AU, respectively. The separate values of the logarithmic temperature derivatives are α/sub i/=-1.14 +- 0.24 and α_0=+0.28 +- 0.13, respectively. Whereas the inner value of α, α/sub i/, agrees with a previous estimate (α/sub c/=-0.9 +- 0.1) using data measured within high speed compression zones of simple high speed streams, the outer value of α, α_0, is significantly more positive than any previous theoretical or experimental estimate. A likely explanation is a modest thermal coupling between the protons and electrons by way of kinetic instabilities driven by the generally observed, double streaming proton velocity configurations. The core electron temperature of about 1 x 10^5 K measured using Mariner 10 instrumentation at 0.47 AU is also significantly less than any value predicted by current models of the high speed solar wind at that distance.

COSMOLOGY

REFER ALSO TO CITATION(S) 5101

5029 **Supernovae as a standard candle for cosmology.** Colgate, S.A. (New Mexico Institute of Mining and Technology, and Los Alamos Scientific Laboratory). *Astrophys. J.;* **232**: No. 2, 404-408(1 Sep 1979).

Supernovae can perhaps be found at Z$\simeq$1 using the Space Telescope and the Focal Plane Camera (cryogenic charge coupled devices) at a rate of approximately four per week using 3 hours per week of viewing time. If Type II supernovae are used as a self-calibrating candle at Zvery-much-less-than1, then Type I's can be calibrated from Type II's as a secondary standard candle (2 mag brighter) and used instead of Type II's for a less difficult determination of q_0. This assumes all Type I's are the same independent of Z whereas each Type II is self-calibrated. Adequate statistics of supernovae in nearby galaxies Z$<$ or $\simeq$1 can further verify the uniqueness of Type I's. Three-color wide-band photometry performed over the period of the maximum luminosity of a Type I gives the time dilation proportional $(1+Z)^{-1}$, color shift proportional $(1+Z)^{-1}$, and apparent luminosity proportional$Z^{-2}[1+0.5(1+q_0)\ Z+O\ (Z)]^{-2}$ $(1+Z)^{-2}$. A Type I supernova at maximum and Z=1, H_0=50, should give rise to a statistically meaningful maximum single pixel signal of $\sim$250 photoelectrons compared to an average galaxy center background of $\sim$25 photoelectrons for an 80 s integration time. An average of $\sim$100 large galaxies (10^{10}L/sub sun/) per field allows $\sim 10^4$ galaxies to be monitored using 3 hours of viewing time. Z can be determined by time dilation and color shift sufficiently accurately

that the determination of q_0 will have twice the error of the calibration of Type I as a standard candle.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 5030

ATMOSPHERIC PHYSICS

5030 (LA—7488-MS) **Outer geosciences.** Blake, R.L. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 58p. Dep. NTIS, PC A04/MF A01.

This report presents an objective discussion of the importance of the atmospheric/solar-terrestrial system to national energy programs. A brief sketch is given of the solar-terrestrial environment, extending from the earth's surface to the sun. Processes in this natural system influence several energy activities directly or indirectly, and some present and potential energy activities can influence the natural system. It is not yet possible to assess the two-way interactions quantitatively or to evaluate the economic impact. An investment by the Department of Energy (DOE) in a long-range basic research program would be an important part of the department's mission. Existing programs by other agencies in this area of research are reviewed, and a compatible DOE program is outlined. 18 figures, 5 tables.

AURORAL AND IONOSPHERIC PHENOMENA

5031 (AD-A—062239) **Development of a rocket-borne resonance lamp system for the measurement of atomic oxygen.** Howlett, L.C.; Baker, K.D. (Utah State Univ., Logan (USA). Space Science Lab.). Aug 1977. Contract F19628-74-C-0130. 87p. NTIS PC A05/MF A01.

Two small rocket payloads containing atomic oxygen resonance lamps and detectors were flown during twilight and night conditions to measure atomic oxygen profiles from 70 to 130 km. The payloads each consisted of a closed, flowing rf excited, modulated, oxygen resonance lamp producing on the order of 10^{13} photons/sec sr of 130.2, 130.4, 130.6 nm oxygen triplet radiation. The emissions were generated with minimal self reversal. The lamp output was baffled into a beam 38 deg wide normal to the payload axis. A segment of this beam was viewed by a photon counting detector designed for good sensitivity at 130 nm while rejecting Lyman-alpha and wavelengths beyond 130 nm. The system absolute calibration was achieved by two totally independent techniques. The first technique required a knowledge of all physical parameters associated with the system, i.e., lamp intensity, directivity, spectrum, atomic oxygen scattering cross section, temperatures, overall instrument geometry, and detector quantum efficiency. The second technique utilized the measurement of zenith 5577 nm intensity at the time of launch and an atmospheric model to place the absolute scale on the measured relative O profile.

5032 (AD-A—064153) **Ionosphere research. Semi-annual status report no. 2, 1 April-30—September 1978.** (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 30 Sep 1978. Contract N00014-77-C-0041. 55p. NTIS PC A04/MF A01.

Contents: Planetary Atmospheres; E and F Regions; D Region; Mass Spectrometer Measurements; Direct Measurements; Atmospheric Reactions; Particle Collection and Ionosphere Composition Studies Using Rocket Borne Probes.

MAGNETOSPHERIC PHENOMENA

5033 (AD-A—062488) **Research, analysis, development, and application of highly integrated systems of multi-phases of the physics of the upper atmosphere. Final report 15 January-15 July 1978.** Bass, J.N.; Bhavnani, K.H.; Lai, S.T.; Roberts, F.R.; Spiegelman, D.L. (Minnesota State Planning Agency, St. Paul (USA). Power Plant Siting Div.). 15 Oct 1978. Contract F19628-78-C-0049. 210p. NTIS PC A10/MF A01.

A variety of computer programs is used to fulfill the different requirements, generated by the various research programs, for satellite orbit data. Revisions to these programs are presented which enlarge the input/output capabilities, improve the accuracy of calculations, or extend the range of problems that can be addressed. Results are presented of investigations of the comparative accuracy of available programs for satellite orbit prediction and solar ephemeris calculation. Occasionally large-scale computer codes useful for geophysical analyses, but developed elsewhere, must be adapted to the needs of AFGL research programs and modified for use on the 6600 system. Cases in point are a code for predicting the proton and electron environments in the magnetosphere and another for transforming between geomagnetic and geographical coordinate systems. Modifications to these programs and procedures for their operational usage are presented. Atmospheric density modeling plays an important role in satellite orbit determination. Results are presented for efforts to incoporate new density models into orbit determination programs, evaluate the performance of different density models in orbit determination applications, and provide methods for model development by applying multiple regression to experimental data.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

5034 **Interaction potentials and their effect on crystal nucleation and symmetry.** Hsu, C.S.; Rahman, A. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* 71: No. 12, 4974-4986(15 Dec 1979).

Molecular dynamics technique has been used to study the effect of the interaction potential on crystal nucleation and the symmetry of the nucleated phase. Four systems, namely rubidium, Lennard-Jones, rubidium-truncated, and Lennard-Jones-truncated, have been studied each at reduced density 0.95. Two types of calculations were performed. Firstly, starting from a liquid state, each system was quenched rapidly to a reduced temperature of ~0.1. The nucleation process for these systems was monitored by studying the time dependence of temperature and the pair correlation function, and the resulting crystalline structure analyzed using among other properties the Voronoi polyhedra. Only in the case of rubidium was a b.c.c. structure nucleated. In the other three cases we obtained a f.c.c. ordering. Secondly, we have studied the effect of changing the interaction potential in a system which has already achieved an ordered state under the action of some other potential. After establishing a b.c.c. structure in a rubidium system, the change in the symmetry of the system was studied when the pair potential was modified to one of the other three forms. The results from both types of calculations are consistent: the rubidium potential leads to a b.c.c. structure while the other three potentials give an f.c.c. structure. Metastable disordered structures were not obtained in any of the calculations. However, the time elapse between the moment when the system is quick-quenched and the moment when nucleation occurs appears to depend upon the potential of interaction.

5035 **Fluorescence quantum yields and radiative and nonradiative lifetimes of glyoxal (^{1}A/sub u/).** MacDonald, B.G.; Lee, E.K.C. (Department of Chemistry, University of California, Irvine, California 92717). *J. Chem. Phys.;* 71: No. 12, 5049-5052(15 Dec 1979).

Fluorescence quantum yields (Phi/sub F/) from single vibronic levels (SVL's) of glyoxal have been measured between 1 and 12 mTorr. The zero-pressure extrapolated values of Phi/sub F/ decrease nearly monotonically from 0.58 for the zeroth vibrational level (0^0) to 0.22 for the $2^1 8^1$ level at E/sub vib/=2126 cm^{-1}. From our values of Phi/sub F/ and the fluorescence decay times (tau/sub F/) measured earlier by Beyer, Zittel, and Lineberger (BZL), the collision-free values of radiative (tau/sub R/) and nonradiative (tau/sub NR/) lifetimes have been obtained. The observed value of tau/sub R/ for the 0^0 level is 4.1 μsec, as compared to the calculated value of 15 μsec estimated from integrated absorption by BZL. Since the observed values of Phi/sub F/ are considerably greater than what had been estimated earlier, the new values for the nonradiative rate (k/sub NR/) are correspondingly smaller. The out-of-plane deformation mode (ν'_8) is most effective as an inducing and promoting mode.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 4759

5036 (AD-A—062332) **Soft x-ray photoemission and charge deposition near material interfaces. Final technical report 17 October 1977-1 Feb 1978.** Strickland, D.J.; Lin, D.L.; Pine, V.W.; Chadsey, W.L. (Science Applications, Inc., McLean, VA (USA)). Aug 1978. Contract F19628-77-C-0181. 103p. NTIS PC A06/MF A01.

The work reported here comes under two distinct headings: soft x-ray photoemission and charge deposition profiles near irradiated material interfaces. The first electron backscatter results using the SXRP code are reported. Good agreement is obtained with measurements for 5 keV electrons incident on Al. The effect of elastic scattering on the photoemission spectrum is analyzed in further detail following the initial observations made in a previous DNA contract. Additional code validation tests plus the good agreement with measurements for backscatter confirm the previous result that scattering significantly effects the photoemission spectrum. A simple technique is presented which relates the inner-shell ionization IMFP to the corresponding photoionization cross section. The technique is tested on the K and L shells of Al and gives IMFP's which agree well with more rigorous results. The development of an empirical photoemission code is reported along with spectra and yields for exploding wire sources incident on Al, Au, Ag, and C. Finally charge deposition profiles for several material configurations con-

taining thin foils are obtained with the POEM code and compared with data by Frederickson. In general, good agreement is achieved.

5037 (AD-A—062467) Inelastic collisions of excited atoms. Report for March-November 1978. Gillen, K.T.; Coggiola, M.J. (SRI International, Menlo Park, CA (USA)). 22 Nov 1978. Contract N00014-76-C-0118. 4p. NTIS PC A02/MF A01.

This report describes the development and verification of a technique for optically pumping fast metastable rare gas beams in order to monitor, and then substantially alter, the beam composition. The technique has been successfully applied to a neon metastable beam produced by charge transfer of neon ions in sodium at energies near 1 keV.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 5036, 5052, 5063, 5081

5038 Resonance fluorescence as a probe to elucidate mechanisms of intramolecular relaxation processes. Chen, K.; Yeung, E.S. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *J. Chem. Phys.;* **71**: No. 12, 4941-4950(15 Dec 1979).

Density matrix formalism is used to study resonance fluorescence processes of isolated gaseous molecules. The Wangsness—Bloch—Fano theory is applied to the irreversible intramolecular relaxation process. In the present treatment, it is assumed that the rotational angular momentum J is a constant of motion in the zeroth order approximation. Thus intramolecular interactions can be classified as tensor operators with respect to J. The fluorescence decay patterns depend on excitation bandwidths and monitoring conditions. Under narrow band excitation, the population (monopole), orientation (dipole), and alignment (quadrupole) of the excited state density matrix rho/sub e/ can be prepared. For a sharply prepared angular momentum state under pulsed excitation, the population does not undergo radiationless decay and the resonance fluorescence intensity is a sum of three exponentials in general. For cw experiments, where lifetime limited linewidth or polarized fluorescence intensities are measured, the population can decay via an intramolecular relaxation channel providing the orientation component is initially prepared. Explicit J dependences of lifetimes are given for pulsed experiments. Under broad band excitation, quantum beats due to the coherence of rho/sub e/ are derived from the Liouville equation. Most important of all, the population can decay under pulsed, broad-band excitation conditions. The scalar part of the nonadiabatic coupling becomes an additional contributor to the intramolecular relaxation process in this last case.

5039 Ab initio SCF and CI calculations of the dipole moment function of ozone. Curtiss, L.A.; Langhoff, S.R.; Carney, G.D. (Chemical Engineering Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **71**: No. 12, 5016-5021(15 Dec 1979).

The constant and linear terms in a Taylor series expansion of the dipole moment function of the $^1A_1$ ground state of ozone are calculated with Cartesian Gaussian basis sets ranging in quality from minimal to double zeta plus polarization. Results are presented at both the self-consistent field and configuration—interaction levels. Although the algebraic signs of the linear dipole moment derivatives are all established to be positive, the absolute magnitudes of these quantities, as well as the infrared intensities calculated from them, vary considerably with the level of theory.

5040 Repulsive intermolecular potential between two H_2 molecules. Ree, F.H.; Bender, C.F. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Chem. Phys.;* **71**: No. 12, 5362-5375(15 Dec 1979).

Ab initio calculations of the intermolecular potential Phi between two H_2 molecules have been carried out for intermolecular separations corresponding to the repulsive region of Phi. In most of the calculations a contracted Gaussian basis set consisting of two s and one p functions per H was used to construct a self-consistent field (SCF) configuration and SCF plus all singly and doubly excited configurations at fixed H—H bond length. To ascertain the accuracy of the computed results, three types of more elaborate calculations were carried out. These are based on a larger Gaussian basis set (five s and two p functions per H), full configuration interaction, and variation of the H—H bond length. We found that Phi depends weakly on these factors at $r <$ or ≈ 4.5 bohr. Analytic expressions are presented to represent Phi in terms of intermolecular distance and three angles defining orientations of two H_2 molecules. The minimum-energy orientation of two H_2 as they approach each other is predicted to have a simple shape, two H_2 forming a parallelogram. The results obtained in this work are compared with those for other Phi's obtained from theoretical and experimental considerations. Since Phi's based on the condensed-state data are less repulsive than the ab initio Phi, we conclude that the many-body effects in condensed states are significant over a nearly entire range of repulsion.

5041 Spontaneous emission lifetimes in the ground electronic states of HD^+ and H_2^+. Peek, J.M.; Hashemi-Attar, A.; Beckel, C.L. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Chem. Phys.;* **71**: No. 12, 5382-5383(15 Dec 1979).

Excited state lifetimes are reported for spontaneous emission from 22 excited vibrations of HD^+ and 19 excited vibrations of H_3^+, in their ground electronic states. (AIP)

5042 Comment in reply to K. D. Jordan and P. D. Burrow's "Comment on the negative ion states of fluorobenzenes". Christophorou, L.G.; Schweinler, H.C. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **71**: No. 12, 5385-5386(15 Dec 1979).

The comments of K.D. Jordan and P. D. Burrows on the symmetry assignments of anion states of fluorobenzene is termed inadequate. Another assignment is suggested (AIP)

5043 One-electron spectrum of Xe VIII. Roberts, J.R.; Knystautas, E.J.; Sugar, J. (Center for Radiation Research, National Bureau of Standards, Washington, D.C. 20234). *J. Opt. Soc. Am.;* **69**: No. 11, 1620-1622(Nov 1979).

The spectrum of Xe VIII has been observed in a theta-pinch discharge. New line identifications were made that determine the energies of the 6s, 7s, 6p, and 5f terms relative to the 5s ^{2}S ground state and confirm the previously known 5p and 5d terms. An independent system of levels derived from the observed 4f-ng (n = 5,6) transitions was found. Its position relative to the ground state is obtained from a predicted value for the 5g effective quantum number n*. From the ns series (n=5—7) a value for the ionization enegy of 105.91 +- 0.05 eV was derived.

5044 /sup 138,139/La nuclear electric-quadrupole-moment ratio by laser-rf double resonance. Childs, W.J.; Goodman, L.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **20**: No. 5, 1922-1926(Nov 1979).

The laser-rf double-resonance technique has been used to obtain 1-ppm measurements of the largest hyperfine intervals in the ground ($5d6s^2\ ^2D$/sub 3/2/) and first excited ($5d6s^2\ ^2D$/sub 5/2/) atomic levels of 0.09% abundant ^{138}La with a beam of unenriched lanthanum. The hfs ratios A^{138}/A^{139} and B^{138}/B^{139} are thereby obtained. The former shows a 0.36% hyperfine anomaly with respect to the NMR ratio of the nuclear g factors. The uncertainty in the new value $B^{138}/B^{139} = +2.27 +- 0.04$ arises from uncertainties in interpreting the hyperfine-anomaly effects observed. The /sup 138,139/La isotope shift is evaluated for both of the lines studied.

5045 Resonance ionization spectroscopy and one-atom detection. Hurst, G.S.; Payne, M.G.; Kramer, S.D.; Young, J.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Rev. Mod. Phys.;* **51**: No. 4, 767-820(Oct 1979).

Resonance ionization spectroscopy, RIS, is a multistep photon absorption process in which the final state is the ionization continuum of an atom. The RIS process can be saturated with available pulsed lasers, so that one electron can be removed from each atom of the selected type. This method was first applied to the determination of the absolute number of Hes(2^1S) excited states produced when pulsed beams of protons interacted with helium gas. Laser schemes for RIS are classified into five basic types; with these, nearly all of the elements can be detected with commercially available lasers. A periodic table is included showing schemes applicable to all of the elements except He, Ne, F, and Ar. A compact theory of the RIS process is presented which delineates the conditions under which rate equations apply. Questions on the effects of collisional line broadening, laser coherence time, and nonresonant multiphoton ionization processes are discussed. The initial demonstration of one-atom detection of Cs is described. By using laser beams to saturate the RIS process and proportional counters as single-electron detectors, one-atom detection is made possible. With RIS, one-atom detection is highly selective, has the ultimate in sensitivity, and has excellent space and time resolution. Furthermore, a modification of the technique in which single electrons (or single ions) are detected with a channel electron multiplier permits single-atom detection in a vacuum. The authors describe how RIS can be used for photophysics measurements such as far wing collisional line broadening, measurements of photoionization cross sections for excited states, and collisional redistribution among excited states.

5046 Exchange mixing at L/sub II,III/ x-ray edges. Kolber, M.A.; Dow, J.D. (Univ. of Illinois, Urbana). *J. Phys. Soc. Jpn.;* **45**: No. 3, 855-859(Sep 1978).

The Onodera model of electron-hole exchange coupling at an L/sub II,III/ x-ray edge is extended to give a lineshape formula expressed in terms of experimentally accessible quantities, and to provide a means of accounting approximately for the energy dependences of both the absorption spectrum above threshold and the exchange interaction. The experimental implications are discussed. 13 references, 4 figures.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

REFER ALSO TO CITATION(S) 4976

5047 (LBL—8233, pp 133-137) **Diagonalization techniques.** Shavitt, I. (Battelle Memorial Inst., Columbus, OH). 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

Various diagonalization techniques are described for the configuration interaction. Included are the Lancaos, Davidson, and perturbation-variation methods; simultaneous iterations for several roots; and simultaneous coordinate relaxation. References only are listed for methods based on partitioning perturbation theory. 11 references. (JFP)

COLLISION PHENOMENA

5048 (AD-A—062163) **Calculation of electron impact cross sections from metastable states. Final report 8 October 1973-October 1977.** Flannery, M.R. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). Aug 1978. Contracts F33615-74-C-4003;F33615-76-C-2003. 216p. NTIS PC A10/MF A01.

A multi-channel eikonal theoretical treatment of atomic collisions is developed with electron-metastable atom collisions in mind. The treatment is applied to electron-impact excitation of hydrogen and helium atoms in their ground state and of helium initially in its metastable level. Differential integral cross sections are calculated together with the orientation and alignment parameters. Cross sections for ionization of metastable rare-gas atoms and of metastable nitrogen and carbon monoxide molecules by collision with electrons are also calculated as a function of electron impact energy.

5049 (AD-A—062610) **Selected topics from the theory of electron-atom and atom-atom collisions. Interim report March 1976-March 1978.** Morrison, W.F.; Flannery, M.R. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). Aug 1978. Contract F33615-76-C-2033. 201p. NTIS PC A10/MF A01.

The quantal elastic, diffusion and viscosity cross-sections have been calculated for proton-helium, neon, argon, krypton, potassium ion-helium, neon and lithium ion-helium systems by means of standard phase shift sums over angular momentum. The classical diffusion and viscosity cross-sections for the above ion-rare gas systems and for the potassium ion-argon, lithium ion-neon, argon and sodium ion-helium, neon, argon were also calculated. At low relative momenta, the classical cross-sections serve only as a 'mean' about which the quantal cross sections oscillate, but the agreement improves with increasing relative momenta. The Vainshtein, Presnyakov and Sobel'man approximation was shown to be applicable to the excitation of metastable helium by electron impact. The cross-section up to 500 eV for electron-metastable helium collisions were calculated. Contrary to expectation, excitation to the optically-forbidden levels dominate that to the optically-allowed levels at energies below 100eV. The use of the Massey-Mohr approximation in the theory of atomic collisions is discussed. It is shown to have rather general application.

5050 (AD-A—063876) **Collision induced dissociation of diatomic molecules. Final report, January 1976-June 1978.** Bailey, W.F. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH (USA)). Nov 1978. 278p. NTIS PC A13/MF A01.

A discrete collisional theory of dissociation under equilibrium and nonequilibrium conditions using a quantum kinetic approach to molecular energy transfer was investigated. The kinetic equations for molecular dissociation in a pure diatomic gas and diatomic gases in the presence of an inert diluent were formulated and solved. The incubation time was calculated and exhibited good agreement with experimental measurements. An analytic steady-state form for the vibrational population and dissociation rate was developed which agreed with the time-dependent calculations. It was determined that rotational states play a significant role in the dissociation process and that the standard ladder model is inadequate. When rotational effects are properly included in the analysis, good agreement with experimental data is obtained. The kinetics developed to address thermal dissociation under equilibrium conditions was extended to treat the highly nonequilibrium conditions achieved through intense optical pumping or electron impact excitation. The nonequilibrium treatment included a detailed investigation of electron impact dissociation. A parametric study of heavy particle and electron impact dissociation rates revealed that under conditions typically encountered in electric discharges, electron impact dissociation dominates the heavy particle rate.

5051 (AD-A—064077) **Projectile energy dependence of aluminum and silicon Kα x-ray satellites. Master's thesis.** Sonobe, B.I. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Aug 1978. 88p. NTIS PC A05/MF A01.

The K alpha satellite spectra of aluminum and silicon produced by collisions with 5.4 to 40.6 MeV helium ions, 12.0 to 74.1 MeV carbon ions, and 23.4 to 117.0 MeV neon ions have been measured. The apparent average L-vacancy fractions (P /sub L/) determined from the relative intensities of the satellite peaks were observed to be dependent on the projectile energy and atomic number and on the target atomic number. Comparisons of the binary-encounter approximation (BEA) and semiclassical approximation (SCA) predictions with the experimental P/sub L/ values as a function of the projectile-to-L-shell electron velocity ratio for helium on aluminum are presented. It was found that the BEA greatly over-predicted the degree of L-shell ionization and failed to predict accurately the shape of the velocity dependence. The SCA predicted the shape of the dependence at the higher velocities but was too low in magnitude.

5052 (AD-A—064098) **Energy transfer in a $^2E^+$ OH II. vibrational. Technical report.** Lengel, R.K.; Crosley, D.R. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Nov 1978. 73p. NTIS PC A04/MF A01.

Vibrational energy transfer within the A state of OH and OD has been studied. A frequency doubled tunable dye laser excites individual N', J' levels in v'=1 or 2, and the intensities of rotationally resolved fluorescence emitted in the presence of collision partners (helium, argon, hydrogen, deuterium and nitrogen) furnishes state-to-state transfer rates. It is found that the transfer rates are strongly dependent on initial rotational level (decreasing as the rotational quantum number increases), that the final rotational state distributions are near thermal but hot, that isoenergetic transfer is small, and that the magnitudes for transfer 1 to 0, 2 to 0 are all similar. The rates themselves are large; for example, with nitrogen the cross section for 1 to 0 transfer with N=3 is 21 square Angstrom. The results taken together, are supportive of a long-lived collision in which anisotropic attractive forces are of importance in the dynamics of the entrance channel.

5053 (BNL—26759) **$C_{3,4}^-$ molecular ion structure determination by Coulomb explosion.** Goldring, G.; Eisen, Y.; Thieberger, P.; Wegner, H.E. (Brookhaven National Lab., Upton, NY (USA); Center for Nuclear Research, Soreq (Israel); Weizmann Inst. of Science, Rehovoth (Israel)). 1979. Contract EY-76-C-02-0016. 13p. (CONF-790889—1). Dep. NTIS, PC A02/MF A01.

From Workshop on physics with fast molecularion beams; Argonne, IL, USA (20 Aug 1979).

The purpose of this experiment is to acquire structural information about multiple atom carbon molecules through their Coulomb explosion in thin carbon foils. The data presented here relate to the structure of C_3^- and C_4^- molecular ions where the C ions resulting from the Coulomb explosion were detected in polycarbonate sheets. A preliminary analysis of the C_3^- molecular structure data has been made and is presented here; however, the C_4^- molecular data has not yet been analyzed. In the future, it is planned to employ electronic multidimensional detectors with computer storage and analysis to improve the present study and extend it to carbon molecules as large as C_{12}^-.

5054 **Differential elastic and quenching cross sections for Ar*(^{3}P) and $CO_2(X^1\Sigma/sub\ g/^+)$.** Fraites, J.L.; Winicur, D.H. (Univ. of Notre Dame, IN). *Mol. Phys.;* **35**: No. 4, 927-939(1978).

The energy dependence of the differential scattering of metastable Ar*(^{3}P) by ground-state $CO_2(X^1\Sigma/sub\ g/^+)$ was studied at relative kinetic energies from 58 to 126 MeV over an angular range of 5 to 160° cm using crossed molecular beams. The position and curvature of rainbow maxima, which are observed at each energy, are used to obtain parameters for a Lennard-Jones (12,6) spherically symmetric potential. The position of the minimum, r/sub m/ = 5.02 +- 0.65 A, is identical to that for K + CO_2 and the well depth, ϵ = 16.3 +- 0.8 MeV, is about 10% greater. The scattered intensity shows a distinct fall-off on the dark side of the rainbow compared to that expected for elastically scattered Ar*. This depletion, caused primarily by the quenching of Ar*, is analyzed in terms of the optical-shadow model to determine the energy dependence of the observed quenching cross section, which is predicted to have a maximum of 67 A^2 at 193 MeV.

5055 (LBL—9811) **Crossed beam reactive scattering of oxygen atoms and surface scattering studies of gaseous condensation.** Sibener, S.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 243p. Dep. NTIS, PC A11/MF A01.

A high pressure, radio frequency discharge nozzle beam source was developed for the production of very intense ($\geq 10^{18}$ atoms $sr^{-1}\,sec^{-1}$) supersonic beams of oxygen atoms. This source is capable of producing seeded beams of ground state O(^{3}P/sub J/) atoms when dilute oxygen-argon mixtures are used, with molecular dissociation levels exceeding 80% being realized for operation at pressures up to 350 torr. When dilute oxygen-helium mixtures are employed both ground state O(^{3}P/sub J/) and excited state O($^1D_2$)

atoms are present in the terminal beam, with molecular dissociation levels typically exceeding 60% being achieved for operation at pressures up to 200 torr. Atomic oxygen mean translational energies from 0.14 to 0.50 eV were obtained using the seeded beams technique, with Mach numbers as high as 10 (FWHM $\Delta v/v \approx 20\%$) being realized. The IC1, CF_3I, C_6H_6, and C_6D_6 reactions are discussed in detail. The IC1 and CF_3I studies have enabled us to determine an improved value for the bond energy of the IO radical: D/sub o/(IO) = 55 +- 2 kcal/mole. The IO product angular and velocity distributions have been used to generate center-of-mass flux contour maps, which indicate that these two reactions proceed via relatively long-lived collision complexes whose mean lifetimes are slightly shorter than their respective rotational periods. The O(³P/sub J/) + C_6H_6 and C_6D_6 reactions were studied in order to elucidate the reaction mechanism, and, in particular, to identify the primary reaction products produced in these reactions. Finally, a series of beam-surface scattering experiments are described which examined the internal and translational energy dependence of molecular condensation probabilities for collisions involving either CCl_4 or SF_6 and their respective condensed phases. 117 references. (JFP)

5056 (LBL—9955) **Vibrational energy transfer in gas phase water and ammonia.** Hovis, F.E. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 118p. Dep. NTIS, PC A06/MF A01.

Thesis.

The V → T, R relaxation rate for NH_3 (ν_2) was studied from 198°K to 398°K by the method of laser-excited vibrational fluorescence. The self-deactivation rate constant decreases from 2.4 μsec torr^{-1} at 198°K to 0.65 μsec^{-1} torr^{-1} at 398°K. The rate constants for deactivation by He, Ar, N_2, and O_2 are much smaller and show a weak temperature dependence in the opposite direction. The vibrational relaxation rates of the coupled ν_1, ν_3 stretching level manifold and of the $2\nu_2$ bending level in $H_2{}^{16}O$ was studied from 250°K to 400°K using th same method as for NH_3. The ν_1, ν_3 self-deactivation rate goes from 1.4 μsec^{-1} torr^{-1} at 250°K to 0.48 μsec^{-1} torr^{-1} at 400°K. For $2\nu_2$ it goes from 4.5 μsec^{-1} torr to 1.9 μsec^{-1} torr^{-1}. The temperature dependence of the deactivation of both levels by He and Ar is much weaker and the rates are several hundred times slower. Deactivation of ν_1, ν_3 by N_2, O_2, and CO_2 is measured only at 293°K. N_2 and O_2 deactivate ν_1, ν_3 about 5 and CO_2 about 50 times faster than He or Ar.

5057 (LBL—10009) **Multiphoton dissociation of polyatomic molecules.** Schulz, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 139p. Dep. NTIS, PC A07/MF A01.

Thesis.

The dynamics of infrared multiphoton excitation and dissociation of SF_6 was investigated under collision free conditions by a crossed laser-molecular beam method. In order to understand the excitation mechanism and to elucidate the requirements of laser intensity and energy fluence, a series of experiments were carried out to measure the dissociation yield dependences on energy fluence, vibrational temperature of SF_6, the pulse duration of the CO_2 laser and the frequency in both one and two laser experiments. Translational energy distributions of the SF_5 dissociation product measured by time of flight and angular distributions and the dissociation lifetime of excited SF_6 as inferred from the observation of secondary dissociation of SF_5 into SF_4 and F during the laser pulse suggest that the dynamics of dissociation of excited molecules is dominated by complete energy randomization and rapid intramolecular energy transfer on a nanosecond timescale, and can be adequately described by RRKM theory. An improved phenomenological model including the initial intensity dependent excitation, a rate equation describing the absorption and stimulated emission of single photons, and the unimolecular dissociation of excited molecules is constructed based on available experimental results. The model shows that the energy fluence of the laser determines the excitation of molecules in the quasi-continuum and the excess energy with which molecules dissociate after the laser pulse. The role played by the laser intensity in multiphoton dissociation is more significant than just that of overcoming the intensity dependent absorption in the lowest levels. 63 references.

5058 **Electron dissociative attachment rate constants for F_2 and NF_3 at 300 and 500 °K.** Trainor, D.W.; Jacob, J.H. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts 02149). *Appl. Phys. Lett.;* **35**: No. 12, 920-922(15 Dec 1979).

Electron attachment to F_2 and NF_3 has been studied in an electron-beam-controlled gas-discharge apparatus over a range of E/P (2—10 kV/cm atm). These experiments were performed in gas mixtures containing small amounts of the halide molecules (< or ≈1%) in an atmosphere of N_2 which was included to control the average electron energy. We obtained values for the rate constants for dissociative attachment to F_2 and NF_3 as a function of mixture temperature at 300 and 500 °K and applied electric field. These results compare favorably with the rate constants deduced from the absolute cross section for these compounds reported by Chantry.

5059 **Electron energy-loss spectra in molecular fluorine.** Nishimura, H.; Cartwright, D.C.; Trajmar, S. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, California 91103). *J. Chem. Phys.;* **71**: No. 12, 5039-5041(15 Dec 1979).

Electron energy-loss spectra in molecular fluorine, for energy losses from 0 to 17.0 eV, have been taken at incident electron energies of 30, 50, and 90 eV and scattering angles from 5° to 140°. Features in the spectra above 11.5 eV energy loss agree well with the assignments recently made from optical spectroscopy. Excitations of many of the eleven repulsive valence excited electronic states are observed and their location correlates reasonably well with recent theoretical results. Several of these excitations have been observed for the first time and four features for which there are no identification appear in the spectra.

5060 **Low-energy collisions of electrons with highly polar molecules: Orthogonalization and model exchange potentials.** Collins, L.A.; Robb, W.D.; Norcross, D.W. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., A;* **20**: No. 5, 1838-1840(Nov 1979).

The importance of imposing orthogonality constraints on the continuum wave functions calculated from model exchange potentials for electron collisions with the highly polar systems LiH and LiF is demonstrated. The Σ and Pi resonance features in e-LiF collisions, found in earlier model-exchange calculations, disappear upon imposing orthogonality; no evidence for these features is observed in the exact static-exchange calculations.

5061 **Observation of a spin-orbit-induced forbidden x-ray transition in lithiumlike magnesium.** Mowat, J.R.; Jones, K.W.; Johnson, B.M. (Department of Physics, The City College of the City University of New York, New York, New York 10031). *Phys. Rev., A;* **20**: No. 5, 1972-1975(Nov 1979).

High-resolution spectra of delayed x rays emitted by fast foil-excited magnesium ions are found to contain a feature at 1321.45 +- 0.74 eV. That energy is in good agreement with previously measured photon energies for the spin-forbidden radiative transitions ($1s2p^2$) ^{4}P/sup tse/→ ($1s\ ^2$2p) ^{2}P/sup tso/ and ($1s2s2p$) ^{4}P/sup tso/→ ($1s^2$2s) ^{2}S/sup e/ in the three-electron ion. Time-of-flight decay curves taken at 25- and 50-MeV ion energies yield a 170 +- 13 ps lifetime, in good agreement with a recently published theoretical value of 169 ps for the ($1s2p^2$) ^{4}P/sup tse//sub 1/2/ state. The authors argue that, for the conditions of this experiment, the 4P/sup tse//sub 1/2/ state is produced primarily by a two-step collision process: 2s-2p outer-shell excitation followed by 1s-2p inner-shell excitation.

ATOMIC AND MOLECULAR THEORY

5062 (LBL—8233) **Post Hartree-Fock: configuration interaction.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 246p. (CONF-780883—). Dep. NTIS, PC A11/MF A01.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

The workshop contained 10 lectures, one of which appeared previously in ERA. Separate were prepared for nine papers. (JFP)

5063 (LBL—8233, pp 73-90) **Configuration selection methods.** Liu, B. (IBM Research Lab., San Jose, CA); Hay, P.J.; Langhoff, S.R. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

A partial review is presented of quantum chemistry calculations on configuration selection methods in order to understand chemical phenomena, obtain chemical data, and develop and test new quantum chemical methods. Some energy differences between orbitals are given, vibrational quanta for CO, and some force constants of HCN. A method of interacting correlated fragments for Van der Waals interaction is used to find the ground states of He and Mg, for each of which the potential curves are plotted. Also discussed are strategies for handling configurations in CI calculations. The generation of configurations from a multi-reference configuration list is given. 7 references. (JFP)

5064 (LBL—8233, pp 91-124) **Hamiltonian matrix calculation.** Shavitt, I. (Battelle Memorial Inst., Columbus, OH); Paldus, J.; Tanaka, K. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

Notes are presented on some principle problems in H matrix calculations including the determination of formulas, removal of core orbitals from H matrix calculations, use of particle-hole formalism, formulas for Slater determinants, comparison of Slater determinants and spin-adapted configuration functions, the number of non-zero matrix elements, intermediate procedure, method based on bonded functions, cycles and chains patterns, matrix element formula for bonded functions, unitary group approach, one-electron integral

contributions, use of patterns, data access problem, special ordering approach, and the matrix elements. 57 references. (JFP)

5065 (LBL—8233, pp 125-132) **Formula tape or not.** Davidson, E.R. (Univ. of Washington, Seattle); Yoshimine, M.; Dierksen, G.H.F. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

Some notes are given on computer calculations of the configuration interaction with the use or nonuse of a formula tape. The cases of the direct, indirect, and general configuration interactions are considered, and the advantages and disadvantages of the formula tape are pointed out, the formula tape being needed for either potential surface calculations or a very long integral list. The Munich molecular program system is described. 3 references. (JFP)

5066 (LBL—8233, pp 139-176) **Direct CI method.** Roos, B. (Univ. of Stockholm, Sweden); Bender, C.F.; Shavitt, I. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

The direct configuration interaction method (called direct if the corresponding secular problem is solved directly from the integral references without the explicit construction of a Hamiltonian matrix), which is an extension of the original method to treat more general cases, some of which are considered, is outlined and described using various methods among which are the Duch and Karwowski, vector, and unitary group. 10 references. (JFP)

5067 (LBL—8233, pp 177-190) **Non-standard variational methods.** Meyer, W. (Univ. Kaiserslautern, Germany); Dykstra, C.E.; Das,G.P. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

The results of using various nonstandard variational methods and some of their disadvantages are noted. 6 references. (JFP)

5068 (LBL—8233, pp 191-230) **Perturbation theory.** Bartlett, R. (Battelle Memorial Inst., Columbus, OH); Kirtman, B.; Davidson, E.R. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

After noting some advantages of using perturbation theory some of the various types are related on a chart and described, including many-body nonlinear summations, quartic force-field fit for geometry, fourth-order correlation approximations, and a survey of some recent work. Alternative initial approximations in perturbation theory are also discussed. 25 references. (JFP)

5069 (LBL—8233, pp 231-243) **Coupled cluster theory.** Pople, J.A. (Carnegie Mellon Inst., Pittsburgh, PA); Paldus, J. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

It is noted that the coupled-cluster theory (limited to double substitutions) is size-consistent and is equivalent to configuration interaction for a two-electron system, but it is not variational (does not lead to an energy upper bound). The configuration interaction (limited to double substitutions) is not size-consistent. Perturbation theory (Moeller-Plesset) may converge slowly. Coupled-cluster theory with double substitutions, its wave function, CEZEK equations, equations for a-vector, and computation times for the Moeller-Plesset theory are considered. The spin-adapted form of the coupled-cluster equations is discussed. 12 references (JFP)

5070 (LBL—8233, pp 245-256) **Logistics and program design.** Diercksen, G.H.F. (Max-Planck Inst. fuer Physik und Astrophysik, Muenchen, Germany); Yoshimine, M.; Hay, P.J.; Bender, C.F.; Langhoff, S.R. 1978.

From Workshop on study of post Hartree-Fock: configuration interaction; Berkeley, CA, USA (14 Aug 1978).

The problem of building a program system by linking different programs under the conditions that the programs, subprograms, mathematics, algorithms, and coding blocks can easily be updated, modified, or substituted is presented. The Munich molecular program system is diagramed and discussed with regard to the heirachy levels and standard data interfaces. Several computer codes are briefly outlined. (JFP)

5071 **Coherent dynamics of N-level atoms and molecules. IV. Two- and three-level behavior.** Shore, B.W.; Cook, R.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., A;* **20**: No. 5, 1958-1964(Nov 1979).

The authors demonstrate special cases for which the resonantly excited N-level atom displays particularly simple periodic behavior involving only two levels. The cases, which occur when first and last transitions are weak, have analytic solutions. A striking difference is noted between even-N and odd-N, related to the resonance structure of the dressed (N-2) -level atom.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 5220

PROPERTIES AND STRUCTURE OF FLUIDS

REFER ALSO TO CITATION(S) 5050

5072 (AD-A—064846) **Laser diagnostics in metallic plasmas. Final report, 1 June 1974-31 October 1978.** Bach, D.R. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Dec 1978. 65p. NTIS PC A04/MF A01.

The major objectives of the research described was the study of diagnostic techniques for metallic plasmas produced by exploded wire systems. Work accomplished included the development of a diamond die for the extrusion of lithium, ray tracing calculations to determine the deflection and absorption of rays passing through the plasma, and a transmission line calculation used for the design of etalons. Measurements made include X-ray temperature determinations by the line ratio method using scintillator detectors. Experiments were also carried out on a large area CdS detector for the measurement of infrared radiation. A two-wavelength holographic interferometer was designed, constructed, tested, and used for the measurement of density distribution in the exploded wire plasma and a Z-pinch. The useful measurements were made with the system at the ruby doubled frequency, as the transmission through the plasma was greater at this wavelength. The exploded wire system has been modified to accept solid wires of tungsten and aluminum which can be fed from outside the vacuum system and a new X-ray measuring system has been constructed.

HIGH ENERGY PHYSICS

5073 (COO—1764-367) **Experimental and theoretical high energy physics. Progress report, October 1, 1978-September 30, 1979.** (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1979. Contract EY-76--C-02-1764. 34p. Dep. NTIS, PC A03/MF A01.

Theoretical and experimental high energy physics is summarized. A list of publications is included. (JFP)

5074 (TT—74-52000/03) **Ukrainian Physics Journal.** Translation of *Ukr. Fiz. Zh. (Russ. Ed.);* **17**: No. 3, vp.(Mar 1972). 196p. (AEC-tr—7411/3). Dep. NTIS, PC A09/MF A01.

A cover-to-cover translation into English of the March 1972 issue (vol. 17, no. 3) of Ukrainskii Fizicheskii Zhurnal is presented. This issue contained a variety of articles on high-energy, plasma, nuclear, and solid-state physics and properties of materials. Individual articles in scope for NSA were abstracted from the original-language publication. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

5075 (LBL—9912) **Muon scattering into 1 to 5 muon final states.** Clark, A.R.; Johnson, K.J.; Kerth, L.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Fermi National Accelerator Lab., Batavia, IL (USA); Princeton Univ., NJ (USA). Joseph Henry Labs.). Sep 1979. Contract W-7405-ENG-48. 16p. (CONF-790885—3). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

Interactions of 209- and 90-GeV muons within a magnetized-steel calorimeter have produced final states containing one, two, three, four, and five muons. Redundant systems of proportional and drift chambers, fully sensitive in the forward direction, maintained 9% dimuon-mass resolution and high acceptance for multimuon final states. The first data are presented on $F_2(x, Q^2)$ from charged lepton-nucleon scattering spanning a range in ln (ln, Q^2) comparable to that measured in high energy neutrino scattering. The muon data confirm the decrease of F_2 with rising Q^2 in the region $0.2 < x < 0.6$, in agreement with QCD expectations. From >80% of the world sample of fully-reconstructed 3μ final states containing the J/psi(3100), the first determination of the psi polarization yields σ/sub L//σ/sub T/ = $\xi^2 Q^2$/m/sub psi/^{2} with $\xi^2 = 4.0$/sub -2.1/$^{+5.4}$, 2.6 standard deviations above the vector-dominance expectation. A sample of 35539 two-muon final states contains a small excess of high p/sub perpendicular to/ high-Q^2 same-sign pairs and sets limits on neutral heavy lepton production by right-handed currents. Two five-muon final states are observed, of which only one is the likely result

of a pure QED process. A single event with four muons in the final state is interpreted as diffractive b anti b production with anti b → psiX → $\mu^+\mu^-$X and b → μ^- anti ν/sub μ/X. 42 references.

5076 (LBL—9919) **Direct photons from psi(3100) decay.** Ronan, M.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 8p. (CONF-790885—4). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

New results are presented from the Lead Glass Wall experiment (SP26) at SPEAR. Motivation was due to recent Quantum Chromodynamics (QCD) calculations, for the γ + 2 gluons decay mode of orthocharmonium, to search for direct photons from psi(3100) decay. Inclusive γ and π^0 production from psi(3100) decay was measured using the Lead Glass Wall addition to the Mark I detector. π^0 and charged π production are compared and the π^0 decay contribution to the inclusive γ spectrum calculated. An excess of γ's was found which is partly explained by eta production and decay, but a signal of high energy direct photons remains. This excess of direct photons is compared with QCD predictions and previously measured radiative decays of the psi(3100).

5077 **Direct photon production from π^+p interactions at 10.5 GeV/c.** Goshaw, A.T.; Lucas, P.W.; Walker, W.D.; Elliott, J.R.; Evans, L.E.; Fortney, L.R.; Robertson, W.J.; Kim, I.J.; Sun, C.R. (Physics Department, Duke University, Durham, North Carolina 27706). *Phys. Rev. Lett.;* **43**: No. 15, 1065-1068(8 Oct 1979).

We have studied inclusive photon production from π^+p interactions at 10.5 GeV/c and found a source of centrally produced direct photons which accounts for (46 +- 9) % of all photons detected with P/sub L/ * and P/sub T/ between 0 and 20 MeV/c. The experimental data are found to be in good agreement with a calculation of hadronic inner bremsstrahlung.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 5079, 5113

5078 (COO—4831-2) **KN and anti NN scattering below 1.1 GeV/c. Annual progress report, March 1, 1979-February 29, 1980.** Nicholson, H.W. (Mount Holyoke Coll., South Hadley, MA (USA)). Oct 1979. Contract ER-78-S-02-4831. 14p. Dep. NTIS, PC A02/MF A01.

Results of statistically precise measurements of K^-p and anti pp scattering cross sections, obtained in the Low Energy Separated Beam of the Brookhaven National Laboratory Alternating Gradient Synchrotron, are presented and briefly discussed. No evidence for new resonances is found in K^-p backward elastic differential cross section results. In addition, no evidence is seen for either the S(1936) meson or the 2020 resonance in anti pp backward elastic scattering, charge exchange scattering, or in anti pp or anti pd total cross section measurements. 5 references.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 5078

5079 (ORO—3948-11) **Pion interactions at medium energies. Progress report, December 1, 1978-November 30, 1979.** Mayes, B.W. II; Hungerford, E.V. III. (Houston Univ., TX (USA). Dept. of Physics). Oct 1979. Contract EY-76-S-05-3948. 30p. Dep. NTIS, PC A03/MF A01.

Experimental intermediate energy research is summarized. A list of publications is included. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 5087

ELECTROMAGNETIC INTERACTIONS

5080 (TRI-PP—79-27) **Pion photoproduction.** Laget, J.M. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Aug 1979. 21p. (CONF-790847—12). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

A special emphasis is put on the pion photoproduction reactions induced in the few-body systems in the Δ-resonance energy range. The multiple scattering series has been summed explicitly and relevant experiments were carried out to study the corresponding singularities. A possible description of the NΔ interaction is presented. The extensions to the threshold region, as well as to the heavier nuclei, are also presented. 38 references.

5081 **Semiclassical quantization of the electron-dipole system.** Turner, J.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Am. J. Phys.;* **47**: No. 1, 87-88(Jan 1979).

A recent note by Fox called attention to a semiclassical treatment by Fermi in 1925 of the motion of an electron in the field of two stationary positive charges. The similarity of this problem to that of an electron moving in a dipole field prompted the author to investigate the latter system under semiclassical quantization. It is shown that Bohr quantization leads to the value D/sub min/ = 3 $\sqrt{}$ 3/4)ea$_0$ = 1.30ea$_0$ for the minimum dipole moment required to bind an electron. The implied separation of unit dipole charges is identical with a special value for unit positive-charge separation given by Fermi. Furthermore, this semiclassical value of D/sub min/ is more than twice the quantum - mechanical value D/sub min/ = 0.639ea$_0$. 9 references.

5082 **Measuring the spin of the gluon in e^+e^- annihilation.** Ellis, J.; Karliner, I. (Stanford Linear Accelerator Center, CA (USA)). *Nucl. Phys., B;* **148**: No. 1-2, 141-147(1979).

The authors discuss the analysis of possible 3-jet events in e^+e^- annihilation and elsewhere. If one selects events with low thrust, the particles recoiling away from the thrust axis should appear as a pair of back-to-back jets in their centre-of-mass system. The angular distributions of such jets are very different in the case of vector gluon bremsstrahlung from what they would be for scalar gluons, or for the 3-gluon decay of a heavy quarkonium resonance. A similar analysis of 3-jet events in photoproduction is outlined.

WEAK INTERACTIONS

5083 (ANL-HEP-CP—79-21) **Test of quark fragmentation in the quark-parton model framework.** Derrick, M.; Barish, S.J.; Barnes, V.E. (Argonne National Lab., IL (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA); Purdue Univ., Lafayette, IN (USA)). Aug 1979. Contract W-31-109-ENG-38. 17p. (CONF-790885—2). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

The hadronic system produced in charged-current antineutrino interactions is used to study fragmentation of the d-quark. Some problems encountered in separating the current quark-fragments are discussed. The fragmentation function for the current quark is in good agreement with the expectations of the naive quark-parton model and, in particular, there is no evidence of either a Q^2- or x/sub BJ/-dependence. 10 references.

5084 **Interference effects in charmed-meson decays.** Treiman, S.B.; Wilczek, F. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). EY-76-C02-3072. *Phys. Rev. Lett.;* **43**: No. 15, 1059-1062(8 Oct 1979).

According to the standard picture, charmed-hadron decays form a hierarchy, with increasing suppression (in powers of small mixing angles) as one goes from $\Delta C/\Delta S = 1$ to 0 to -1 processes. This Letter discusses several kinds of effects that might enhance the contributions from second-order suppressed amplitudes, namely, effects which involve their interference with leading amplitudes.

5085 **Semileptonic decays on the D meson.** Bacino, W.; Ferguson, T.; Nodulman, L.; Slater, W.; Ticho, H.; Diamant-Berger, A.; Donaldson, G.; Duro, M.; Hall, A.; Irwin, G.; Kirkby, J.; Merritt, F.; Wojcicki, S.; Burns, R.; Condon, P.; Cowell, P.; Kirz, J. (Physics Department, University of California, Los Angeles, California 90024). DE-ACD3076F00515. *Phys. Rev. Lett.;* **43**: No. 15, 1073-1076(8 Oct 1979).

The electron energy spectrum in the process e^+e^- → psi" (3770) → e^{+-} +(>2 charged particles) has been used to determine the D (56%D^0 + 44%D^+) semileptonic branching ratio. Assuming the Glashow-Iliopoulos-Maiani model, it is found that the inclusive branching ratio is b (D → Xeν) = 0.080 +- 0.015 and the state X is dominated by K and Kπ. The fraction of K$\pi e\nu$ is (37 +- 16) % if the Kπ system is entirely K^* (890), or (55 +- 21) % if the Kπ system is nonresonant. Within the assumptions of the analysis, the D lifetime is calculated to be (2.5 +- 1.6) x 10^{-13} sec.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 5082

GENERAL

REFER ALSO TO CITATION(S) 5086

FIELD THEORY

5086 (LA-UR—79-2829) **Axial currents, supercurrents and anomalies in supersymmetric QED.** Clark, T.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790989—1). Dep. NTIS, PC A02/MF A01.

From Supergravity workshop; Stony Brook, NY, USA (26 Sep 1979).

The currents associated with the superconformal symmetries are defined as moments of the supercurrent, V/sub μ. All of the current (non-) conservation equations are known once the generalized trace of the supercurrent, D/sup α/V/sub $\alpha\alpha$/, is found. The superconformal anomalies are shown to have coefficients given by β of the Callan-Symanzik equation. In super QED there is an additional U(1) axial current whose anomaly has a coefficient with no radiative corrections. 5 references.

5087 **Polarization of high—transverse-momentum single photons as a test of quantum chromodynamics.** Devoto, A.; Pumplin, J.; Repko, W.; Kane, G.L. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev. Lett.;* **43**: No. 15, 1062-1065(8 Oct 1979).

It is shown that high—transverse-momentum photons originating from the process quark + gluon → quark + photon exhibit a substantial linear polarization in perturbative quantum chromodynamics. The angular dependence of the polarization is quite sensitive to the non-Abelian structure of the interaction, and can be used to check the equality of the quark-gluon and three-gluon couplings.

5088 **Probing higher-order quantum chromodynamics: Charge-conjugation asymmetries from two-gluon exchange.** Brown, R.W.; Sahdev, D.; Mikaelian, K.O. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). *Phys. Rev. Lett.;* **43**: No. 15, 1069-1072(8 Oct 1979).

We consider charge-conjugation asymmetries arising from two-gluon exchange and gluon-bremsstrahlung corrections in color-averaged quark-antiquark and quark-quark scattering. At large momentum transfers, such considerations lead to sizable predictions for forward-backward and particle-antiparticle asymmetries in hadron collisions. Jet-antijet differences are discussed and the cleanest tests involve the heavier quarks. The absence of mass singularities and the relationship to two-photon asymmetries are emphasized.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 5074, 5127

5089 (BNL-NCS—26844) **Open problems in nuclear data evaluations.** Pearlstein, S. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-791058—23). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Nuclear data measurements are often discrepant or incomplete. Despite these difficulties, after reviewing the information at hand, experts periodically prescribe their best estimates of nuclear data for use by scientists. Some of the obstacles the experts face are poor energy calibrations, inadequate data, overly detailed data, and the necessity for coalescing multidisciplinary information. These and other aspects of nuclear data evaluation are discussed.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5091

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

5090 (LBL—9706) **Nuclear reactions producing ^{2}He and excited states of ^{4}He as unbound outgoing systems.** Stahel, D.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 152p. Dep. NTIS, PC A08/MF A01.

A system has been developed to detect the unbound outgoing reaction products ^{2}He ($^{1}S_0$ state of the pp system) and α^* (excited states of ^{4}He below E/sub x/ = 25 MeV) by way of a kinematically complete coincidence measurement of the breakup particles p + p and p + t, respectively. 110 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

5091 **Inclusive electron scattering from ^{3}He.** Day, D.; McCarthy, J.S.; Sick, I.; Arnold, R.G.; Chertok, B.T.; Rock, S.; Szalata, Z.M.; Martin, F.; Mecking, B.A.; Tamas, G. (University of Virginia, Charlottesville, Virginia 22901). *Phys. Rev. Lett.;* **43**: No. 16, 1143-1146(15 Oct 1979).

Data on inclusive electron scattering from ^{3}He over a large range of momentum transfer (2—7 fm^{-1}) are presented and compared with a one-nucleon knockout calculation based on a Faddeev spectral function.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5119

5092 **Microscopic and macroscopic model calculations of relativistic heavy-ion fragmentation reactions.** Morrissey, D.J.; Oliveira, L.F.; Rasmussen, J.O.; Seaborg, G.T.; Yariv, Y.; Fraenkel, Z. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405=ENG-48. *Phys. Rev. Lett.;* **43**: No. 16, 1139-1142(15 Oct 1979).

The possibility of observing previously postulated neutron-proton correlations in the nuclear ground state via relativistic heavy-ion reactions is examined. The isotope-production cross sections from the reaction of 213-MeV/nucleon ^{40}Ar with ^{12}C are calculated with a correlated abrasion-ablation model and with an uncorrelated intranuclear cascade model, and the results compared to recent experimental data. The neutron-proton correlations may only be visible in products near the mass of the fragmenting nucleus.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5090, 5094

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5090

5093 (LA-UR—79-2902) **Neutron total cross section measurement at WNR.** Lisowski, P.W.; Moore, M.S.; Morgan, G.L.; Shamu, R.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-791058—9). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The techniques involved in measuring fast-neutron total cross sections at the Weapons Neutron Facility (WNR) of the Los Alamos Scientific Laboratory are described. Results of total cross section measurements on natural carbon covering the range 2.5 to 250 MeV are presented. 16 references.

5094 **Pure neutron and pure proton transitions in inelastic scattering of pions by ^{13}C.** Dehnhard, D.; Tripp, S.J.; Franey, M.A.; Kyle, G.S.; Morris, C.L.; Boudrie, R.L.; Piffaretti, J.; Thiessen, H.A. (University of Minnesota, Minneapolis, Minnesota 55455). *Phys. Rev. Lett.;* **43**: No. 15, 1091-1094(8 Oct 1979).

Differential cross sections σ/sub π/ +- (θ) for elastic and inelastic scattering of 162-MeV pions from ^{13}C were measured at momentum transfers between 0.6 and 2.1 h x fm^{-1}. For two inelastic transitions, enhancement of σ/sub π/- over σ/sub π/+ and of σ/sub π/+ over σ/sub π/- were observed which are consistent with the values for pion scattering from free nucleons. The results are discussed qualitatively in terms of simple shell-model and weak-coupling-model configurations.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5090

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5090, 5098

5095 (CONF-791058—31) **Simultaneous evaluation of $^{32}S(n,p)$, $^{54}Fe(n,p)$, $^{63}Cu(n,2n)$ cross sections.** Fu, C.Y.; Hetrick, D.M.; Perey, F.G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Previously available evaluations of cross sections and covariances were used as input for incorporating additional correlated data sets, particularly cross-section ratios. A generalized least-squares technique was employed. The output evaluations have not only updated cross sections and covariances, but also cross-reaction covariances, all of which include the additional data incorporated. 1 figure.

5096 (LA-UR—79-2903) **Neutron total cross section of single crystal silicon at 21°K.** Brugger, R.M.; Fluharty, R.G.; Lisowski, P.W.; Olsen, C.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-791058—8). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The neutron total cross section of a single crystal of Si was studied over the energy range 0.003 eV to 50 eV at the Weapons Neutron Research Facility (WNR). The neutron energies were determined by time of flight. The 28.77 cm long Si sample was held at three temperatures, 296K, 77K, and 20°K. The 21°K temperature was obtained by filling an encircling cryostat with liquid H_2. The region of greatest interest is below 1 eV where Bragg scattering from the perfect crystal is small and where thermal diffuse scattering can be reduced by cooling the Si. Near 0.05 eV the cross section dips to less than 1/5 its value at energies greater than 1 eV. This feature has allowed single crystals of Si to be used very successfully as thermal neutron band pass filters. Data at 296K and 77°K agree with previous measurements. Very little structure caused by Bragg scattering is observed. Measured cross sections for 21°K are somewhat below the 77°K data but not enough lower to justify cooling a Si filter to 21°K to dramatically improve its transmission.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

5097 (LA-UR—79-2834) **Calculation of neutron cross sections on iron between 3 and 40 MeV.** Arthur, E.D.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-791058—13). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The use of high energy d+Li sources to produce neutrons for radiation damage studies will require evaluated neutron cross sections up to energies of 40 MeV. Experimental data in this energy region are scarce, and reliance must be placed upon nuclear model calculations to provide the necessary cross sections. We have thus calculated neutron-induced cross sections on ^{54}Fe and ^{56}Fe between 3 and 40 MeV using the multistep preequilibrium Hauser-Feshbach model code GNASH. Special care was taken in the determination of optical model parameters applicable over this wide energy range through use of, and comparison to, neutron total cross section and elastic angular distribution data, (p,n), and (α,n) data, as well as other high energy proton induced reaction cross sections and spectral results. The preequilibrium-statistical calculations using these parameters as well as gamma-ray strength functions, level densities, and discrete level information reproduce well most available experimental measurements above 3 MeV for varied reaction types including gamma-ray production data. 12 references.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5090, 5102

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5095, 5102

5098 (CONF-791058—32) **Neutron emission spectra induced by 14-MeV neutrons from the Evaluated Nuclear Data File (ENDF/B-V): a critical review.** Hetrick, D.M.; Larson, D.C.; Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Neutron emission spectra induced by 14.6-MeV incident neutrons, retrieved from ENDF/B-V, are graphically compared with experimental data by Hermsdorf et al. and Clayeux and Voignier. The elements selected for the comparisons include Na, Mg, Al, Si, Ca, Ti, V, Cr, Fe, Ni, Cu, Nb, W, and Pb. In addition to comparing the evaluated total neutron emission spectra with experimental data, individually evaluated spectra from contributing reactions are presented. Only a few of the evaluated spectra were found to agree well with the measured spectra, namely, those evaluations which utilized advanced nuclear model codes with precompound effects and competing binary and tertiary reactions. Recommendations for removing several defects in most evaluations are made. 3 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 4976

5099 (BNL—26802) **Measurements of Q/sub β/ for neutron-deficient nuclei with A ~ 80.** Haustein, P.E.; Lister, C.J.; Alburger, D.E.; Olness, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 10p. (CONF-790968—4). Dep. NTIS, PC A02/MF A01.

From 6. international conference on atomic masses; East Lansing, MI, USA (18 Sep 1979).

The isotope ^{80}Y, T/sub 1/2// = 34 sec was observed, and a general investigation of the decay properties of several nuclei in this region was carried out. Measurements of the total decay energy of ^{80}Y and neighboring nuclides serve to explore the interplay between the mass surface and the extent of nuclear deformation as well as providing the first definitive checks of mass theory predictions in this region. The half-lives, gamma ray energies and relative intensities in the decays of ^{79}Sr and ^{80}Y and the ^{80}Y decay scheme are given. Also the Q/sub EC/ was found. 10 references. (JFP)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5099

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5095, 5098, 5103

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5080

5100 (LA-UR—79-2863) **Optical model calculations of nucleon interactions with ^{93}Nb, from 10 keV up to 50 MeV.** Lagrange, C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791058—14). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The neutron spherical optical potential is determined following the SPRT method by a fit to strength functions, scattering radius, total cross section and neutron elastic scattering data. Comparison to the potential obtained with existing proton scattering data, (p,p) (p,n), provides a basis for the determination of the complex symmetry term of the optical potential. Calculations using the J.L.M. optical model will be also presented and discussed. 18 references.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5102, 5103

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5079, 5080, 5098

5101 (LA-UR—79-2900) **Neutron cross sections of importance to astrophysics.** Browne, J.C. (Los Alamos Scientific Lab., NM

(USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-791058—10). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Neutron reactions of importance to the various stellar burning cycles are discussed. The role of isomeric states in the branched s-process is considered for particular cases. Neutron cross section needs for the ^{187}Re-^{187}Os, ^{87}Rb-^{87}Sr clocks for nuclear cosmochronology are discussed. Other reactions of interest to astrophysical processes are presented. 35 references.

5102 Systematics of the isoscalar giant monopole resonance from 60 MeV inelastic proton scattering. Bertrand, F.E.; Satchler, G.R.; Horen, D.J. (Oak Ridge National Lab., TN (USA)); van der Woude, A. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). *Phys. Lett., B;* **80**: No. 3, 198-202(1 Jan 1979).

Evidence for an isoscalar giant monopole resonance is provided for seven nuclei with A > = 58. The resonance excitation energy is approximately 80 X A/sup -1/3/ MeV. For nuclei with A >= 90, nearly 100% of the L = 0, T = 0 energy-weighted sum rule is depleted in the resonance, in agreement with earlier work on ^{208}Pb and ^{144}Sm. Only approximately 30% is found in ^{58}Ni, and no clear evidence is found for localized monopole strength in ^{40}Ca.

5103 Shell effects at high spin in the γ-continuum from Te evaporation residues. Simon, R.S.; Diamond, R.M.; El Masri, Y.; Newton, J.O.; Sawa, P.; Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **313**: No. 12, 209-220(1979).

The continuum γ-ray spectra following ^{110}Pd(^{12}C,xnγ)Te and ^{82}Se(^{40}Ar,xnγ)Te reactions at several bombarding energies have been measured. As in earlier studies, the spectra show three main components: (i) discrete transitions in the ground band, (ii) an yrast 'bump' and (iii) a high-energy statistical tail. In addition, there appears to be a minimum in the spectrum before the yrast bump. The existence of this minimum and of the two peaks of discrete γ-ray transitions indicate a non-rotational structure for the nuclei at low spin (<= 30) before changing at higher spin to the rotational behavior suggested by the bump itself. Theoretical calculations including shell effects do show this type of behavior.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

5104 (LA-UR—79-2833) **Calculation of neutron cross sections for tungsten isotopes.** Arthur, E.D.; Philis, C.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-791058—12). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Neutron-induced cross sections on tungsten isotopes were calculated in the energy range between 1 and 20 MeV using preequilibrium-statistical model techniques. The success of these calculations, which form part of an effort to improve the evaluated neutron and gamma-ray production cross sections for tungsten appearing in ENDF/B, depends strongly on the determination of consistent input parameter sets applicable over the entire range of interest. For example, neutron optical model parameters were derived through a simultaneous analysis of total cross sections, resonance data, and angular distributions. These parameters, when used in multistep Hauser-Feshbach calculations, produce good agreement with varied experimental data such as neutron inelastic scattering excitation functions and (n, 2n) cross sections. Likewise, gamma-ray strength functions were determined through fits to neutron capture data that produce calculated results that compare well to measured gamma-ray production cross sections. A description of the techniques used in such parameter determinations as well as comparison of calculated results to experimental data will be presented.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5102

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5098, 5102

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

5105 Mechanisms of very heavy-ion collisions: the ^{209}Bi + ^{136}Xe reaction at E/sub Lab/=1130 MeV. Schroeder, W.V.; Birkelund, J.R.; Huizenga, J.R. (Rochester Univ., NY (USA). Dept. of Chemistry); Wolf, K.L. (Argonne National Lab., IL (USA)); Viola, V.E. Jr. (Maryland Univ., College Park (USA). Dept. of Chemistry). *Phys. Rep.;* **45**: No. 5, 301-343(Sep 1978).

The mechanisms of kinetic-energy dissipation and nucleon exchange operating in damped heavy-ion collisions and the corresponding time scales are investigated. As an example of a very heavy system, the reaction ^{209}Bi+^{136}Xe at E/sub Lab/=1130 MeV is chosen for a comparison with various reaction models. The experimental data include atomic number, energy and angular distributions of the projectile-like fragments and the correlation between these experimental observables. By means of a simple phenomenological reaction model, l-dependent interaction times are deduced which are used to evaluate proton-number diffusion coefficients. A rather model-independent comparison of the time dependence of the mechanisms of nuclear exchange and kinetic energy dissipation is achieved by using the microscopic time scale provided by the nucleon-exchange mechanism. Energy dissipation is found to be of the one-body type, nucleon exchange contributing about 30% to the total energy loss. A consistent description of the observed reaction phenomena has been achieved in terms of a statistical mechanism of damped reactions evolving in time as nucleons are exchanged and energy is dissipated. It connects in a continuous fashion the domains of quasi-elastic scattering and strongly damped collisions.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5102

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 5102

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

SPONTANEOUS AND INDUCED FISSION

5106 (LA—8047-T) **Statistical model investigation of nuclear fission.** Pepping, R.E. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 256p. Dep. NTIS, PC A12/MF A01.

Thesis.

To assist in the improvement of fission product yield data libraries, the statistical theory of fission was investigated. Calculation of the theory employs a recent nuclear mass formula and nuclear density of states expression. Yields computed with a simple statement of the theory do not give satisfactory results. A slowly varying empirical parameter is introduced to improve agreement between measured and calculated yields. The parameter is interpreted as the spacing between the tips of the fragments at the instant of scission or as the length of a neck in the fissioning nucleus immediateiy prior to scission. With this spacing parameter semi-quantitative agreement is obtained between calculated and measured mass chain yields for six cases investigated, ^{233}U(n/sub th/, f), ^{235}U(n/sub th, f), ^{239}Pu(n/sub th/, f), ^{235}U(n+14, f), ^{238}U(n+14, f), and ^{252}Cf(sf). An indication of the source of mass asymmetry in fission is presented. The model developed predicts a mass and energy dependence of some of the parameters of models currently in use in data generation. A procedure for the estimation of the fission product yields for an arbitrary fissioning system is proposed. 63 references.

5107 (LA-UR—79-2914) **Calculation of prompt fission neutron spectra.** Madland, D.G.; Nix, J.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-791058—22). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A new calculation of the prompt fission neutron spectrum N(E) is presented as a function of both the fissioning nucleus and its excitation energy. The calculation, based upon standard nuclear-evaporation theory, accounts for the physical effects of the distribution of fission-fragment residual nuclear temperature and the energy dependence of the cross section for the inverse process of compound-nucleus formation. With the use of a residual nuclear temperature distribution based upon the Fermi-gas model, calculations were performed for two different assumptions concerning the cross section for compound-nucleus formation. Use of a constant cross section leads to a closed expression for the neutron energy spectrum, while use of an energy-dependent cross section, calculated with the

optical model, yields a numerical integration. Results obtained for the two assumptions agree well with experimental data, although there is a preference for the energy-dependent cross section calculation. 7 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

5108 **Mass spectrometric measurements to determine the half-life of ^{241}Pu.** Garner, E.L.; Machlan, L.A. (National Bureau of Standards, Washington, DC). *Trans. Am. Nucl. Soc., Suppl.;* **33**: No. 1, 3(1979).

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 5111, 5116

NUCLEAR REACTIONS AND SCATTERING

5109 (CONF-791058—33) **Measurement of ^{238}U(n,n'γ)^{238}U* cross sections.** Olsen, D.K.; Morgan, G.L.; McConnell, J.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Production cross sections for gamma-ray transitions produced by 0.5- to 5.0-MeV neutrons on ^{238}U were measured with a 95-cm^3 Ge(Li) detector (at 125°), the ORELA neutron source, and a recoil proton telescope. From these data and other decay scheme information, inelastic scattering cross sections for levels from 680 to 1224 keV of excitation were constructed and compared with statistical model calculations and the ENDF/B-V evaluation. 5 figures.

5110 (CONF-791058—37) **Evaluation of the fission and capture cross sections of ^{240}Pu ;and ^{241}Pu for ENDF/B-V.** Weston, L.W.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Since there were appreciable new data which were not available for ENDF/B-IV, new evaluations for ^{240}Pu and ^{241}Pu were carried out for ENDF/B-V. The evaluation of the fission and capture cross sections is reviewed and problem areas are discussed. The neutron energy range of concern was from 10^{-5} eV to 20 MeV. Significant changes were made over the entire neutron energy region because of the new experimental data available. The problems in the evaluations due to discrepancies in the nuclear data are emphasized, particularly the 1-eV resonance in ^{240}Pu and the 0.3-eV resonance in ^{241}Pu. The evaluation of the fission and capture cross sections for ENDF/B-V represents an improvement over the previous evaluation; however, there continues to be a need for accurate experimental data. 7 figures.

5111 (CONF-791058—39) **Neutron total cross section measurements on ^{249}Cf.** Carlton, R.F.; Harvey, J.A.; Hill, N.W.; Pandey, M.S.; Benjamin, R.W. (Middle Tennessee State Univ., Murfreesboro (USA); Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst., Blacksburg (USA); Savannah River Ecology Lab., Aiken, SC (USA)). 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Neutron total cross section measurements were performed on a sample of ^{249}Cf (5.65 mg total weight) with the ORELA as a source of pulsed neutrons. The sample, the inverse thickness of which was 1542 barns/atom, consisted of 85.3% ^{249}Cf and 14.4% ^{249}Bk, and was cooled to liquid nitrogen temperature. Analyses were also made of data from a thin sample (l/n = 17430) of 65% ^{249}Cf in the region of the large fission resonance at 0.7 eV. Fifty-five resonances in ^{249}Cf were observed and analyzed over the energy range 0.1 eV to 90 eV by use of an R-matrix multilevel formalism. The resonance parameters obtained were used to determine the level spacing and the s-wave neutron and fission strength functions. Thermal total cross section measurements were also performed. 5 figures, 3 tables.

5112 (LA-UR—79-2904) **Total cross section of ^{242}Pu between 0.7 and 170 MeV.** Moore, M.S.; Lisowski, P.W.; Morgan, G.L.; Auchampaugh, G.F. (Los Alamos Scientific Lab., NM (USA); Western Michigan Univ., Kalamazoo (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791058—7). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Various evaluations of the neutron cross sections of ^{242}Pu lead to widely different predictions of bulk neutronics properties such as critical mass. These evaluations also show rather different behavior of the energy dependence of the total cross section. The total cross section of ^{242}Pu from 0.7 to 170 MeV was measured to a statistical accuracy of = 0.5% below 6 MeV, using 8 g of high purity material and the WNR pulsed neutron facility. Recent evaluations by Madland and Young and by Lagrange and Jary are found to be reasonably consistent with the data obtained. Best agreement, however, is found by using a relationship between the total cross sections for ^{238}U, ^{239}Pu, and ^{235}U. The remarkable accuracy of this description for ^{242}Pu suggests that it could be extended to other deformed actinides for which inadequate amounts of material exist for direct measurements of σ/sub T/ in the MeV region, as an evaluation constraint.

5113 **Evidence for a new reaction mechanism in the bombardment of ^{238}U with 11.5-GeV protons.** Wilkins, B.D.; Kaufman, S.B.; Steinberg, E.P.; Urbon, J.A.; Henderson, D.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **43**: No. 15, 1080-1083(8 Oct 1979).

The masses and kinetic energies of coincident heavy fragments emitted from a ^{238}U target bombarded with 11.5-GeV protons were measured as a function of the angle between the fragments. Fragments with nearly equal and opposite laboratory momenta are observed with a total mass as low as ~ 1/2 that of the target and higher kinetic energy than expected from fission, providing evidence for a new reaction mechanism.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 5110

5114 (CONF-791058—5) **^{235}Cf anti ν discrepancy and the sulfur discrepancy.** Smith, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The cantankerous discrepancy among measured values of anti ν for ^{235}Cf appears at last to be nearing a final resolution. A recent review has summarized the progress that has been achieved through revaluation upward by 0.5% of two manganese bath values anti ν and the performance of a new liquid scintillator measurement. A new manganese bath measurement at INEL is in reasonably good agreement with previous manganese bath values of ^{235}Cf anti ν. It now appears that the manganese bath values could still be systematically low by as much as 0.4% because the BNL-325 thermal absorption cross section for sulfur may be as much as 10% low. There is a bona fide discrepancy between measurements of the sulfur cross section by pile oscillators and the values derived from transmission measurements. The resolution of this discrepancy is a prerequisite to the final resolution of the ^{235}Cf anti ν discrepancy. 22 references.

5115 (CONF-791058—27) **Absolute measurement of ν/sub p/-bar for ^{252}Cf by the large liquid scintillator tank technique.** Spencer, R.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A vigorous effect to dispel the scandal of the ~ 2% dispersion in reported experimental values of ^{252}Cf ν-bar, the average number of neutrons emitted in spontaneous fission, has been underway over the past 5 years. The goal is to reduce the uncertainty in this fundamental parameter to the +- 0.25% level needed for reactor physics applications. Both new measurements and revaluation of older measurements are involved. At ORNL a new measurement is being carried out using the leage liquid scintillator neutron detector. Findings of the most recent experiment, incorporating improvements suggested in a preliminary study are discussed. 6 figures, 2 tables.

5116 (CONF-791058—38) **High-resolution fission cross section of ^{231}Pa.** Plattard, S.; Auchampaugh, G.F.; Hill, N.W.; de Saussure, G.; Perez, R.B.; Harvey, J.A. (Los Alamos Scientific Lab., NM (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The ^{231}Pa fission cross section was measured with high resolution at OREA from 0.1 to 12 MeV and between 0.4 eV and 10 keV. The data show evidence for fractionated vibrational structures in the threshold region of the fission cross section, and narrow fission resonances above 0.4 eV with an average fission width < Γ/sub f/ > = 8 μeV. 3 figures, 3 tables.

NUCLEAR THEORY

NUCLEAR STRUCTURE

5117 (AD-A—063954) **X-ray dose enhancement, II. Interim report no. 1.** Chadsey, W.L. (Science Applications, Inc., McLean, VA (USA)). Nov 1978. Contract F19628-77-C-0181. 66p. NTIS PC A04/MF A01.

A discussion of x-ray dose enhancement at material interfaces is presented including definition, problem identification, and worst-case estimation, prediction techniques, and analysis of dose enhancement characteristics. Empirical, analytical, and Monte Carlo prediction techniques are discussed. Dose enhancement calculations for various interface configurations, continuous x-ray sources, and thin high-Z layers are presented.

5118 (UCRL—82587) **Linear least-squares analysis and effective interactions.** Bloom, S.D.; Hausman, R.F. Jr.; Larsen, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 11p. (CONF-790348—6). Dep. NTIS, PC A02/MF A01.

From Conference on the p,n reaction and the nucleon-nucleon force; Telluride, CO, USA (29 Mar 1979).

Some results are shown from the application of the method of singular value analysis (SVA), a particular form of linear least-squares analysis, to two sets of experimental two-body matrix elements, the 63 Chung-Wildenthal matrix elements for the 1d5/2, 1d3/2 shells (A approx. equal to 20 to 40) and th best 84 matrix elements from previous work. The latter cover the atomic weight range of A approx. equal to 40 to 200 and nine shells from 1d3/2 to 1i13/2. The purpose is the extraction of a first-order set of strength parameters for an effective interaction of minimum rank and simple form for each set or both sets of data. The ranges, being nonlinear in their effects, are investigated separately. Mainly considered are local potential forms, which is not a limitation of the approach. 6 references. (JFP)

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 5121

NUCLEAR REACTIONS AND SCATTERING

5119 **New approximation for Glauber theory on stripping of relativistic deuterons.** Nissen-Meyer, S.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., A;* **306**: No. 3, 499-512(28 Aug 1978).

The momentum distribution of forward protons from relativistic collisions of deuterons with nuclei is computed from a Glauber theoretical ansatz of Bertocchi and Tekou. In this paper the outgoing proton-neutron scattering state (disintegrated deuteron) is approximated with a plane wave minus the component of this plane wave along the deuteron bound state vector. With no fitted parameters good agreement is found with data from the reaction $d+C^{12}\rightarrow p+X$ in the region corresponding to non-relativistic Fermi momenta in the forward direction. At more relativistic Fermi momenta, the model deviates more from the data, which can be due to an incorrect choice of the short-distance part of the deuteron wave function as well as to off-shell effects in the deuteron.

5120 (LA-UR—79-2862) **Application of nuclear models.** Young, P.G.; Arthur, E.D.; Madland, D.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-791058—15). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The development of extensive experimental nuclear data base over the past three decades has been accompanied by parallel advancement of nuclear theory and models used to describe and interpret the measurements. This theoretical capability is important because of many nuclear data requirements that are still difficult, impractical, or even impossible to meet with present experimental techniques. Examples of such data needs are neutron cross sections for unstable fission products, which are required for neutron absorption corrections in reactor calculations; cross sections for transactinide nuclei that control production of long-lived nuclear wastes; and the extensive dosimetry, activation, and neutronic data requirements to 40 MeV that must accompany development of the Fusion Materials Irradation Test (FMIT) facility. In recent years systematic improvements have been made in the nuclear models and codes used in data evaluation and, most importantly, in the methods used to derive physically based parameters for model calculations. The newly issued ENDF/B-V evaluated data library relies in many cases on nuclear reaction theory based on compound-nucleus Hauser-Feshbach, preequilibrium and direct reaction mechanisms as well as spherical and deformed optical-model theories. The development and applications of nuclear models for data evaluation are discussed with emphasis on the 1 to 40 MeV neutron energy range.

5121 (LBL—9569) **Nuclear proximity forces.** Randrup, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

It is shown that it is possible to relate approximately the interaction between two finite nuclei to the interaction between two flat parallel slabs of semi-infinite nuclear matter. First a general treatment is given of a gap with gently variable paraboloidal width and other gap or crevice geometries; then the specialization is made to nuclei. 4 references. (JFP)

RADIATION AND SHIELDING PHYSICS

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 5020

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 4509

5122 (CONF-790728—5) **Thermal neutron dosimetry using electrochemical etching.** Su, S.J.; Sanders, M.E.; Morgan, K.Z. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 10 Jul 1979. Contract EY-76-S-05-4814. 16p. Dep. NTIS, PC A02/MF A01.

From 24. annual meeting of the Health Physics Society; Philadelphia, PA, USA (7 Jul 1979).

This study demonstrates the feasibility of using high LET particle radiators to determine the thermal neutron dose by reaction particle registration in low background polycarbonate foils using electrochemical etching. When used in conjunction with the already proven fast neutron recoil particle track registration technique, a viable fast and thermal neutron dosimeter is realized with the advantages of being: non-fading, insensitive to low LET radiation reactions, inexpensive in both processing and materials, useable over a wide dose range, a permanant record and good reproducibility, highly sensitive, and tissue equivalent and a dose equivalent response over a wide range. Most importantly, it finally provides a simple and reliable dosimeter for both the fast and thermal neutron components.

5123 (LA-UR—79-2685) **Dosimetry results for big ten and related benchmarks.** Gilliam, D.M.; Grundl, J.A.; Hansen, G.E. (Los Alamos Scientific Lab., NM (USA); National Bureau of Standards, Washington, DC (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-791051—5). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Measured average reaction cross sections for the Big Ten central flux spectrum are given together with calculated values based on the US Evaluated Nuclear Data File ENDF/B-IV. Central reactivity coefficients for ^{233}U, ^{235}U, ^{239}Pu, ^{6}Li, and ^{10}B are given to check consistency of bias between measured and calculated reaction cross sections for these isotopes. Spectral indexes for the Los Alamos ^{233}U, ^{235}U, and ^{239}Pu metal critical assemblies are updated, utilizing the Big Ten measurements and interassembly calibrations, and their implications for inelastic scattering are reiterated.

5124 (LA-UR—79-2848) **Verification of photon-production processing techniques.** Barrett, R.J.; Ford, W.E. III; Gohar, Y.; Bohn, T.S.; MacFarlane, R.E.; Boicourt, R.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-2405-ENG-36. 5p. (CONF-791058—24). Dep. NTIS, PC A04/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Several laboratories have independently developed computer codes which use evaluated data from the ENDF/B file to produce group-averaged cross sections and transfer matrices for neutron-induced photon production. There have been several instances in which these codes have produced discrepant data sets, and thereby cast doubt on the validity of all the codes. For a series of specified test cases, the results from three of these codes (NJOY, LAPHN-GAS, and MACK-IV) were systematically compared with each other and with hand calculations. Several shortcomings in the codes were discovered and repaired. One major difference of philosophy was resolved. Consequently, the codes have arrived at substantial agreement on all of the nearly 1200 nonzero group constants calculated in the study. 4 figures, 1 table.

DOSIMETRY

REFER ALSO TO CITATION(S) 5117

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 4764, 5034, 5074

5125 (BNL—26769) **Spectral diffusion and ultrasonic attenuation in amorphous materials.** Arnold, W.; Black, J.L.; Weiss, G. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (Germany, F.R.); Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790862—4). Dep. NTIS, PC A02/MF A01.

From 3. international conference on phonon scattering in condensed matter; Providence, RI, USA (28 Aug 1979).

Of the many low-temperature effects attributable to tunneling states (TLS) in glasses, the saturation of the resonant ultrasonic attenuation has proved to be one of the richest. This phenomenon occurs when the flux of phonons is sufficiently high to drive the TLS population out of thermal equilibrium. Up until now, there has been no complete theory to describe what is meant by a sufficiently high phonon flux. Consequently there has been no framework in which one could understand the temperature, frequency, and pulse-length dependences of the saturation threshold in glasses below 1 K. In this paper, a rate-equation theory is presented which contains all the essential processes and agrees qualitatively with experimental results, some of which are presented here.

5126 (COO—3084/72) **Thermodynamics of adsorption at interfaces as it influences decohesion.** Hirth, J.P.; Rice, J.R. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering; Brown Univ., Providence, RI (USA). Div. of Engineering). Jul 1979. Contract EY-76-S-02-3084. 41p. Dep. NTIS, PC A03/MF A01.

Earlier computations on the work of separation of boundaries with adsorbed solute atmospheres are reconsidered in terms of reversible work cycles. Special attention is given to two limiting cases. These are the separation of a material interface under fully equilibrated conditions, for which the chemical potential of the adsorbed solute remains constant, and separation under constrained conditions for which the surface excess solute concentration remains constant (i.e., the same on the two newly created free surfaces as present initially on the unstressed interface). The results are consistent with the limiting cases treated before and include the extension to more general cases of solute interactions, including multi-component systems. The work terms are conveniently represented on diagrams of chemical potential versus surface excess solute concentration. A general separation process is then represented as a path in this diagram which begins on the adsorption isotherm for the unstressed interface and ends on the adsorption isotherm for the pair of newly created surfaces.

5127 (TT—74-52000/02(Vol.17)(No.2)) **Ukrainian Physics Journal.** Translation of *Ukr. Fiz. Zh. (Russ. Ed.);* **17**: No. 2, vp.(Feb 1972). 203p. (AEC-tr—7411/2(Vol.17)(No.2)). Dep. NTIS, PC A10/MF A01.

A cover-to-cover translation into English of the February 1972 issue (vol. 17, no. 2) of Ukrainskii Fizicheskii Zhurnal is presented. Many of the articles concerned solid-state physics, properties of materials, or plasma physics; others dealt with high-energy and nuclear physics. Individual articles in scope for NSA were abstracted from the original-language publication. (RWR)

5128 (TT—74-52000/01(Vol.17)(No.1)) **Ukrainian Physics Journal.** Translation of *Ukr. Fiz. Zh. (Russ. Ed.);* **17**: No. 1, vp.(Jan 1972). 218p. (AEC-tr—7411/1(Vol.17)(No.1)). Dep. NTIS, PC A10/MF A01.

A cover-to-cover translation into English of the January 1972 issue (vol. 17, no. 1) of Ukrainskii Fizicheskii Zhurnal is presented. Most of the articles dealt with solid-state physics. Individual articles in scope for NSA were abstracted from the original-language publication. (RWR)

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 4747, 4810

5129 **Relationship between the critical field and energy gap of a superconductor.** Stewart, G.R. (Los Alamos Scientific Lab., NM (USA)). *Solid State Commun.;* **30**: No. 7, 415-417(May 1979).

The theory of Lewis concerning the relationship between the critical field and the exponent of the superconducting electronic specific heat is found to be verified over an extended region of this exponent in the light of new data. If the identification of this exponent with the zero temperature energy gap is valid, then the theory of Toxen, for large energy gaps, is found to be incorrect.

5130 (LBL—8500) **Kinetic study of the formation of the superconducting A15 phase in the Nb-Al-Si system.** Binh-Phung. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01. Thesis.

So far, aluminum-containing superconductors showed excellent critical fields and temperatures. Powder Metallurgy shows the most promise in producing these particular kinds of superconductors in the near future. The scope of this research is to apply a kinetic study to observe the behavior of the Nb(Al,Si) system at elevated temperatures. From such observations, an optimized method of obtaining the A15 superconducting phase can be achieved. This study has resulted in a two step heat treatment to obtain the A15 phase. For the primary heat treatment of infiltrated rods, 600°C for 11 hours or 650°C for 1 hour was found suitable to form a barrier of intermetallic compound around the pores. For the secondary heat treatment, 1700°C for 15 seconds resulted in the formation of the A15 superconducting phase with a critical temperature of 18.25°K. A15 formation for wires is similar to infiltrated rods. The only difference is the diffusion path which is now much shorter. 600°C for 1 hour was found suitable for the primary heat treatment and 1700°C for 15 seconds was the most suitable for the secondary heat treatment. The highest critical temperature found thus far was 18.78°K.

5131 **Flux-line cutting in type II superconductors.** Brandt, E.H.; Clem, J.R.; Walmsley, D.G. (Ames Laboratory: USDOE and Department of Physics, Iowa State University, Ames, Iowa). *J. Low Temp. Phys.;* **37**: No. 1, 43-55(1 Oct 1979).

Experimental evidence for flux-line cutting in superconductors (intersection and cross-joining of singly quantized vortices) is briefly reviewed. The interaction energy between two straight vortices tilted at an angle α (not $=0$) is then shown to be finite in the London model, i.e., in the limit of vanishing core radius. Next, the activation energy and maximum interaction force are calculated for the vortices in an analytic approximation to the Ginzburg—Landau theory. Here two competing interactions determine the behavior. Electromagnetic repulsion ($0<\alpha<\pi/2$) varies as cos α and decays over distances scaled by the penetration depth λ, while core attraction is independent of α and varies over distances scaled by the coherence lenght ξ. The force is always repulsive at large flux-line separation ($0<\alpha<\pi/2$) and its maximum decreases rapidly as κ decreases, so that flux-line cutting is expected to be more probable in low-κ materials. The calculations provide a basis for explaining longitudinal flux-flow resistance as well as some intriguing magnetization behavior in the same configuration.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 5081, 5134

5132 (AD-A—063978) **Remarks on the Schroedinger operator with singular complex potentials. Technical summary report.** Brezis, H.; Kato, T. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Aug 1978. Contract DAAG29-75-C-0024. 22p. NTIS PC A02/MF A01.

Schroedinger operators of the form A = delta + V(x), where delta is the Laplacian and V is a scalar potential, arise in quantum mechanics and other areas. Delicate questions concerning what domain should be assigned to A must be settled in order to have a good theory. These questions are answered here for a very general class of potentials V which may even have complex values.

OPTICS

5133 **Reconstruction of spherically symmetric objects from slit-imaged emission: limitations due to finite slit width.** Mueller, M.M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Opt. Lett.;* **4**: No. 11, 351-353(Nov 1979).

A simple method for reconstructing spherically symmetric objects from slit-imaged emission was recently described by Vest and Steel. Although this method is valid for infinitesimal slit widths and practically noise-free irradiance data, it is shown here that its validity does not extend to slits of practical width in the laser-fusion program. However, a method is given for reducing the Vest—Steel plots with practical apertures to obtain information on core diameter, shell diameter, and shell thickness.

STATISTICAL PHYSICS AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 5126

MATHEMATICAL PHYSICS

5134 Time-dependent variational principle and the effective action. Jackiw, R.; Kerman, A. (Massachusetts Inst. of Tech., Cambridge). Contract EY-76-C-02-3069. *Phys. Lett., A;* 71: No. 2/3, 158-162(30 Apr 1979).

The time-dependent variational principle used in derivations of time-dependent Hartree-Fock theory gives a variational definition for the effective action - the generating functional of single-particle irreducible n-point functions. 17 references.

FUSION ENERGY

REFER ALSO TO CITATION(S) 5074

PLASMA RESEARCH

REFER ALSO TO CITATION(S) 5127

PLASMA CONFINEMENT AND HEATING

5135 (PPPL—1588) **Fast wave heating in the Princeton Large Torus.** Hosea, J.C.; Arunasalam, V.; Bernabei, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1979. Contract EY-76-C-02-3073. 17p. Dep. NTIS, PC A02/MF A01.

Fast wave heating in the ion cyclotron range of frequencies (ICRF) is being studied on the Princeton Large Torus (PLT) to evaluate its potential for heating large reactor-scale toroidal plasmas. Of primary interest are the two-ion and pure second harmonic heating regimes which, with proper control of the ion energy distribution and the rf power deposition profile, permit substantial energy glow into the bulk plasma ions. Initial heating experiments have been conducted with a single 1/2 turn antenna up to wave powers of P/sub rf/ $\approx$ 350 kW for durations of $\geqq$ 100 ms in the two-ion regime under conditions for which direct fundamental cyclotron damping on the minority ion species dominates the wave absorption. Ion-ion coupling serves to heat the majority ions and for energetic minority ion energy distributions, energy flow to the electrons results from electron drag. Substantial ion heating is found for D-p mixtures; ΔT/sub d/(0) $\approx$ 600 eV for 350 kW with anti n/sub e/ $\approx 2 \times 10^{13}$ cm^{-3}. The deuteron heating efficiency is improved by about a factor of $\sim$ 2 in D^{-3}He mixtures; ΔT/sub d/(0) $\approx$ 500 eV for 150 kW with anti n/sub e/ $\approx 2.1 \times 10^{13}$ cm^{-3}.

5136 (PPPL—1607) **Ordinary-mode fundamental electron cyclotron resonance absorption and emission in the Princeton Large Torus.** Efthimion, P.C.; Arunasalam, V.; Hosea, J.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

Fundamental electron cyclotron resonance damping for 4 mm waves with ordinary polarization is measured for propagation along the major radius traversing the midplane of the plasma in the Princeton Large Torus (PLT). Optical depths obtained from the data are in good agreement with those predicted by the relativistic hot plasma theory. Near blackbody emission over much of the plasma midplane is obtained and, in conjunction with the damping measurements, indicates that the vessel reflectivity is high. The practical use of ordinary mode fundamental electron cyclotron resonance heating (ECRH) in existing and future toroidal devices is supported by these results.

5137 (PPPL—1610) **Plasma heating r and d assessment.** Jassby, D.L.; Berkner, K.H.; Colestock, P.L.; Freeman, R.L.; Haselton, H.H.; Hosea, J.C.; Rome, J.A.; Scharer, J.E.; Sheffield, J.; Stewart, L.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.; General Atomic Co., San Diego, CA (USA); Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA); Exxon Nuclear Co., Inc., Bellevue, WA (USA)). Nov 1979. Contract EY-76-C-02-3073. 40p. Dep. NTIS, PC A03/MF A01.

The purpose of this report is to compare the heating requirements of INTOR with the present state-of-the-art of tokamak plasma heating technology and demonstrated heating performance, and also with the technology expected by 1983-84 according to development and testing programs in place. This comparison results in a set of recommendations for a heating technology development program for the 1980s.

5138 (UCID—18308) **Improved performance of tandem mirrors with thermal barriers.** Kaiser, T.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

As originally conceived, tandem mirrors with thermal barriers are limited by MHD instabilities to values of central-cell β that are significantly lower than those attainable in tandems without barriers. Much of the degradation in performance is due to the introduction of a new region of unfavorable field line curvature in the central cell. From a variational calculation that maximizes central cell fusion power subject to constraints on the vacuum field energy and allowable interchange instability drive, I derive an analytic expression for a central cell magnetic field strength profile for which the new instability drive is greatly reduced. As a result, central cell performance is enhanced to a point approaching that of tandem mirrors without barriers. Formulas showing how β/sub c/ and fusion power scale with design parameters are also derived.

5139 Inverse-bremsstrahlung absorption rate in an intense laser field. Schlessinger, L.; Wright, J. (R D Associates, Marina del Rey, California 90291). *Phys. Rev., A;* 20: No. 5, 1934-1945(Nov 1979).

Inverse bremsstrahlung is one of the important mechanisms for heating plasmas with lasers. In the intense fields required for laser fusion, processes involving multiphoton effects are very important. This paper reviews and compares the different approaches used to quantify the effect of intense fields on the inverse-bremsstrahlung absorption rate. The quantum-mechanical treatment of this problem requires summation of the contribution of large numbers of photons. Numerical problems associated with this summation have made direct evaluation difficult. In this paper the authors describe a method, applicable to many potentials of interest, for transforming the sum over a large number of complicated terms into a rapidly converging sum. Numerical results for both classical and quantum treatments are presented and compared, and the errors introduced by several approximations are quantified.

PLASMA DIAGNOSTICS

5140 (ORNL/TM—7034) **Remarks on the use of deposition probes for analysis of tokamak boundary-layer plasmas.** Vernickel, H. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

The deposition of impurities and plasma ions on probes exposed in plasma devices can be used as a diagnostic method for characterizing boundary-layer plasmas. Recent tokamak experiments have shown that quantitative measurements of impurity and plasma particle profiles can be obtained from ion scattering and nuclear reaction analysis of samples exposed in the plasma edge. For such measurements to become meaningful diagnostics, they must be related to the plasma edge behavior. In the present work a simple analytic model of the boundary-layer plasma is utilized to explore the relationship between the deposition profile on such probes and the particle confinement time and ionization probability of wall-originated impurities in the boundary layer.

5141 (UCRL—82923) **Mirror fusion test facility plasma diagnostics system.** Thomas, S.R. Jr., Coffield, F.E.; Davis, G.E.; Felker, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—21). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

During the past 25 years, experiments with several magnetic mirror machines were performed as part of the Magnetic Fusion Energy (MFE) Program at LLL. The latest MFE experiment, the Mirror Fusion Test Facility (MFTF), builds on the advances of earlier machines in initiating, stabilizing, heating, and sustaining plasmas formed with deuterium. The goals of this machine are to increase ion and electron temperatures and show a corresponding increase in containment time, to test theoretical scaling laws of plasma instabilities with increased physical dimensions, and to sustain high-beta plasmas for times that are long compared to the energy containment time. This paper describes the diagnostic system being developed to characterize these plasma parameters.

5142 Striated filamentary sparks produced by a CO_2 TEA laser. Schmieder, R.W. (Sandia Laboratories, Livermore, California 94550). *Opt. Lett.;* 4: No. 11, 369-371(Nov 1979).

Sparks in the form of long, thin filaments having quasi-periodic longitudinal light and dark regions (striations) in time-integrated images have been ovserved in various gases using a CO_2 TEA laser. Typically, a 50-mJ pulse will produce a filament 1 cm long and 130 μm in diameter, with more than 150 striations spaced 50 μm apart in atmospheric air. Each striation is associated with the formation of a plasma region by one pulse in train of pulses from the mode-locked laser, and the filament results from the formation of successive (nearly identical) region, each displaced from the previous one toward the laser. The possible use of these sparks as a light source in diagnostics is noted.

PLASMA KINETICS - GENERAL

5143 (COO—2387-112) **Abstracts of papers presented at the twenty-first annual meeting of the Division of Plasma Physics of the American Physical Society.** (Wisconsin Univ., Madison (USA)). 1979. Contract EY-76-S-02-2387. 11p. Dep. NTIS, PC A02/MF A01.

Abstracts of 16 papers are included. (MOW)

5144 (COO—2387-115) **Experimental observation of plasma paramagnetism in a tokamak.** Holly, D.J.; Prager, S.C.; Phillips, M.W.; Sprott, J.C. (Wisconsin Univ., Madison (USA)). Sep 1979. Contract EY-76-S-02-2387. 11p. Dep. NTIS, PC A02/MF A01.

The increase in the toroidal magnetic field of a tokamak due to plasma presence is measured experimentally and compared with predictions of an equilibrium code.

5145 (COO—4636-2) **Fusion reactor physics and technology. Progress report, October 1, 1978-June 30, 1979.** Conn, R.W.; Kulcinski, G.L.; Maynard, C.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 1979. Contract ET-78-S-02-4636. 141p. Dep. NTIS, PC A07/MF A01.

During the present contract period, work has been carried out in the following areas: (a) The NUWMAK tokamak reactor design was completed and distributed throughout the community. In particular, specific work was completed on divertorless tokamak operation in NUWMAK, Ti alloy assessment, materials resource implications of NUWMAK style reactors, and an economic analysis; (b) Tandem mirror reactor technology studies were carried out on tandem mirror physics, the role of rf heating, power balance studies, the design of high field magnets, and blanket/shield design in TMR's; (c) work at Wisconsin is contributing to the evolving picture of an optimum TMR; (d) the WHIST tokamak reactor plasma transport code developed at Wisconsin has been extended in two directions; (e) Work on ICRF heating in tokamak reactors, both in terms of physics and launching structure design, has been completed and published.

PLASMA KINETICS - THEORETICAL

5146 (AD-A—062418) **Quest: a quasi-equilibrium transport code for high-beta systems. Memorandum report.** Hui, B.H.; Liewer, P.C.; Book, D.L. (Naval Research Lab., Washington, DC (USA)). Jul 1978. 69p. NTIS PC A04/MF A01.

This report describes the quasi-equilibrium compression and transport code, QUEST. The code is designed to study diffusion, thermal conduction, and ohmic and compressional heating in high-beta plasma systems (beta = ratio of plasma pressure to magnetic field pressure). These systems include Z-pinches, theta pinches, belt pinches and reversed field configurations. The code allows variations only in the radial direction and operates on a slow (diffusion and compression) time scale so that pressure balance is maintained. The conducting wall at the outer boundary of the system can be moved arbitrarily to simulate plasma compression produced by an imploding liner. This report also provides instructions on the use of the code, including a listing and sample input and output for verification.

5147 (AD-A—064212) **Electron-electron collisions. a simple model for partially ionized gases. Master's thesis.** Hastings, H.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 101p. NTIS PC A06/MF A01.

The electron-electron collision term of the steady-state Boltzmann equation is replaced by a simple relaxation term that effectively linearizes the equation. Additional assumptions are made to simplify the equation further. Ionization is ignored and a two-level atom is assumed. The effects of a DC electric field are included. Using the relaxation term to account for electron-electron collisions, an approximate analytic solution is derived. Temporal and steady-state characteristics of the relaxation term are compared to those of the standard Fokker-Planck term. The relaxation term is judged invalid for energies greater than the excitation threshold.

5148 (AD-A—065149) **Investigation of nonideal plasma properties. Final report, 1 November 1977-30 November 1978.** Wilhelm, H.E.; Hong, S.H.; Choi, S.H. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). Dec 1978. Contract N00014-78-C-0117. 155p. NTIS PC A08/MF A01.

The report contains theoretical work on pressure ionization, exchange energy, and degeneracy effects in high pressure plasmas. In the numerical examples, alkali plasmas are discussed. In addition tables of the Sommerfeld inegrals of degenerate electron gases are presented. With regard to the acceleration of plasmas in high density plasmas, a critical analysis of the propagation of wave packets is given within the frame of conventional (parabolic) quantum theory.

5149 (AD-A—065157) **Plasma theory and simulation. Quarterly progress report No. 3, 1 July-30 September 1978.** Birdsall, C.K.; Fawley, W.; Chen, Y.J.; Harned, D.; Lee, J.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 30 Sep 1978. Contracts N00014-77-C-0578;EY-76-S-0034. 23p. NTIS PC A02/MF A01.

Contents: Plasmas with Field Reversal; Simulations of Drift Cyclotron Instability; ES1 Code; Adaptation of ES1 to Use Post Processor ZED; 1 1/2d Particle-Fluid Hybrid Model for Lower Hybrid Drift Wave Instability; and RJET (Mini-User's Center) Development.

5150 (LA-UR—79-2755) **Numerical treatment of linearized equations describing inhomogeneous collisionless plasmas.** Lewis, H.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791201—2). Dep. NTIS, PC A02/MF A01.

From 4. IRIA international symposium on computing methods in applied science and engineering; Versailles, France (10 Dec 1979).

The equations governing the small-signal response of spatially inhomogeneous collisionless plasmas have practical significance in physics, for example in controlled thermonuclear fusion research. Although the solutions are very complicated and the equations are different to solve numerically, effective methods for them are being developed which are applicable when the equilibrium involves only one nonignorable coordinate. The general theoretical framework probably will provide a basis for progress when there are two or three nonignorable coordinates.

5151 (LA-UR—79-2896) **R-matrix analyses of light-element reactions for fusion applications.** Hale, G.M.; Dodder, D.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-791058—16). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Comprehensive R-matrix analyses of reactions in light systems done at LASL contain cross-section information of interest in fusion applications. Results for analyses of the 4-, 5-, 6-, and 7-nucleon systems are presented, with particular emphasis on cross sections for the T(d,n), D(d,n) D(d,p), T(p,2n), and ^{6}Li(p,^{3}He) fusion reactions.

5152 (LA-UR—79-3308) **1979 CECAM workshop on transport of fast electrons in laser fusion plasmas. Progress report.** Mason, R.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

Attention is given to three problem areas in laser-driven electron transport: (1) ion-acoustic turbulence as a source of inhibition, (2) the effects of anti E times anti j heating of the thermals, and (3) the possibility of thermal inhibition by thermal electron runaway or trapping.

5153 (ORNL/CSD/TM—93) **Information and advice on the numerical software available for the Fusion Energy program at Oak Ridge.** Gaffney, P.W. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Nov 1979. Contract W-7405-ENG-26. 88p. Dep. NTIS, PC A05/MF A01.

The purpose of this report is to describe some of the numerical routines that have been obtained for the Fusion Energy program at Oak Ridge. The report is organized by problem area. Each area contains a list of relevant numerical routines. These routines are described in detail and, where appropriate, we give advice on their correct use. Furthermore, we have ranked the subroutine libraries NAG, IMSL, and HARWELL according to how satisfactory their routines are for that particular area. In an Appendix we provide information on how to access the routines and the subroutine libraries described in this report. Moreover, we describe a growing online data base which contains a condensed version of the information in this report.

5154 (PPPL—1556) **Particle stochasticity due to magnetic perturbations of axisymmetric geometries.** Mynick, H.E.; Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 41p. Dep. NTIS, PC A03/MF A01.

The quasilinear theory of collisionless test particle diffusion in stochastic magnetic fields is extended to include the effects of finite gyroradius rho and particle drifts (including magnetic trapping). A canonical framework is used, in which both the criterion for onset of stochasticity and the diffusion tensor scale with field-particle coupling coefficients g/sub l/. The g/sub l/ contain all the information about a given particle's unperturbed orbit and the perturbation fields with which it interacts. The modification of transport due to finite rho and drifts is thus found by comparison of the g/sub l/ including these effects to their driftless, rho $\rightarrow$ o limit.

5155 (PPPL—1596) **Separating variables in two-way diffusion equations.** Fisch, N.J.; Kruskal, M.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Princeton Univ., NJ (USA). Dept. of Astrophysical Sciences). Oct 1979. Contract EY-76-C-02-3073. 43p. Dep. NTIS, PC A03/MF A01.

It is shown that solutions to a class of diffusion equations of the two-way type may be found by a method akin to separation of

variables. The difficulty with such equations is that the boundary data must be specified partly as initial and partly as final conditions. In contrast to the one-way diffusion equation, where the solution separates only into decaying eigenfunctions, the two-way equations separate into both decaying and growing eigenfunctions. Criteria are set forth for the existence of linear eigenfunctions, which may not be found directly by separating variables. A speculation with interesting ramifications is that the growing and decaying eigenfunctions are separately complete in an appropriate half of the problem domain.

5156 (PPPL—1600) **Fluctuations and transport in an inhomogeneous plasma.** Nevins, W.M.; Chen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 38p. Dep. NTIS, PC A03/MF A01.

A formalism is developed for calculating the equilibrium fluctuation level in an inhomogeneous plasma. This formalism is applied to the collisionless drift wave in a sheared magnetic field. The fluctuation level is found to be anomalously large due to both the presence of weakly damped normal modes and convective amplification. As the magnetic shear is reduced, the steady-state fluctuation spectrum is found to increase both in coherence and in amplitude. The transport associated with this mode is evaluated. The diffusion coefficient is found to scale as D is proportional to B²/nT/ sup 1/2/.

5157 (PPPL—1604) **Transport code studies of INTOR at PPPL.** Singer, C.E.; Post, D.E.; Rutherford, P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 24p. Dep. NTIS, PC A02/MF A01.

This report summarizes transport modeling studies carried out with the BALDUR one-dimensional transport code for the International Tokamak Reactor INTOR. This report has been written to provide an accessible compilation of INTOR plasma simulation results, and to be included as part of the documentation provided by the Modeling Subcommittee. The reference transport model and results of plasma simulations using this model are described. Particular attention is paid to the length of the heating pulse needed for ignition, and the value of the plasma pressure at ignition. The particle fluxes through the plasma boundary are also reported. The results of varying the assumptions in the reference machine design and transport model are reported. Particular attention is paid to the problem of variations in the assumed plasma confinement, since this is a major source of uncertainty in reactor design. The conclusions of this study are summarized.

5158 (UCID—18303) **Velocity distribution in a pinched beam.** Lee, E.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Sep 1979. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

An explicity procedure is given for distributing transverse velocities to simulate a self pinched beam of specified density profile. The flat top, Bennett and Gaussian profiles are worked examples.

PLASMA PRODUCTION

5159 (COO—4631-9) **Experimental test of resonant absorption theory. Progress report, July 1-September 30, 1979.** Yablonovitch, E. (Harvard Univ., Cambridge, MA (USA)). Oct 1979. Contract ED-78-S-02-4631. 3p. Dep. NTIS, PC A02/MF A01.

The scaling of the hot electron temperature, T/sub h/, with laser intensity, I, has been studied with the laser-shockfront interaction apparatus. The preliminary result for 500 psec laser pulses of intensity I ~ 10^{14} W/cm² is T/sub h/ infinity I/sup α/, where α = .35 to .40.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 5156

5160 (COO—2387-116) **Axisymmetric instability in a noncircular tokamak: experiment and theory.** Lipschultz, B.; Prager, S.C.; Todd, A.M.M.; Delucia, J. (Wisconsin Univ., Madison (USA)). Sep 1979. Contract EY-76-S-02-2387. 49p. Dep. NTIS, PC A03/MF A01.

The stability of dee, inverse-dee and square cross section plasmas to axisymmetric modes has been investigated experimentally in Tokapole II, a tokamak with a four-null poloidal divertor. Experimental results are closely compared with predictions of two numerical stability codes -- the PEST code (ideal MHD, linear stability) adapted to tokapole geometry and a code which follows the nonlinear evolution of shapes similar to tokapole equilibria. Experimentally, the square is vertically stable and both dee's unstable to a vertical nonrigid axisymmetric shift. The central magnetic axis displacement grows exponentially with a growth time approximately 10^3 poloidal Alfven times plasma time. Proper initial positioning of the plasma on the midplane allows passive feedback to nonlinearly restore vertical motion to a small stable oscillation. Experimental poloidal flux plots are produced directly from internal magnetic probe measurements.

5161 (NRL-MR—4088) **Electromagnetic instabilities in a focused ion beam propagating through a z-discharge plasma.** Ottinger, P.F.; Mosher, D.; Goldstein, S.A. (Naval Research Lab., Washington, DC (USA)). 15 Oct 1979. Contract ES-77-A-01-6021. 26p. Dep. NTIS, PC A03/MF A01.

A beam-plasma system consisting of a focused light ion beam propagating through a z-discharge plasma is analyzed for electromagnetic velocity space instabilities. In particular, the Weibel (k B = 0, k V/sub z/ ≃ 0) and the Whistler (k X B ≃ 0, k V/sub z/ = 0) instabilities are studied. It is found that unstable modes do not grow fast enough to affect the beam propagation in a pellet-fusion-reactor chamber. For k V/sub z/ ≧ 0, the instabilities convect with a velocity much less than the beam streaming velocity.

5162 (PPPL—1560) **General theory of kinetic ballooning modes.** Frieman, E.A.; Rewoldt, G.; Tang, W.M.; Glasser, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1979. Contract EY-76-C-02-3073. 76p. Dep. NTIS, PC A05/MF A01.

The ballooning mode formalism, previously developed for the ideal MHD problem, is applied here to the kinetic problem in tokamaks. The general two-dimensional equation governing drift and trapped-electron eigenmodes reduces to a one-dimensional integral equation along the lines of force with the radial structure determined by a WKB procedure. Comparisons made between the present one-dimensional code and a previous two-dimensional code embodying identical physical assumptions indicate reasonable agreement. This correspondence holds both for the structure along the field line and for the radial structure in the special case of closely spaced turning points.

5163 (PPPL—1602) **Parametric decay into ion cyclotron waves and drift waves in multi-ion-species plasma.** Ono, M.; Porkolab, M.; Chang, R.P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Bell Labs., Murray Hill, NJ (USA)). Oct 1979. Contract EY-76-C-02-3073. 86p. Dep. NTIS, PC A05/MF A01.

Parametric decay processes near the ion cyclotron frequency are investigated experimentally and theoretically in multi-ion species plasmas. The relevant theoretical dispersion relation of the parametric coupling is derived, including the ion drift motion. Experiment data obtained in the Princeton L-4 device verifies these theoretical predictions in some detail. In a helium-neon plasma, the relative ion drift motion excites electrostatic ion cyclotron waves (the kinetic ion-ion hybrid mode) when $\Omega_0 > \Omega$/sub He/ + Ω/sub Ne/. In a region of large density gradient, the ion drift motion also excites low frequency drift waves when $\Omega_0 > \Omega$/sub He/ + Ω/sup */. The experimental data are found to agree well with the theory. The relevance of these processes to ICRF heating of fusion plasmas is pointed out.

PLASMA WAVE PHENOMENA

5164 (COO—5069-13) **Low frequency fluctuations of the ohmically heated plasma in the Proto-Cleo torsatron.** Casper, T.A.; Shohet, J.L. (Wisconsin Univ., Madison (USA). Engineering Experiment Station). Jul 1979. Contract ET-78-S-02-5069. 15p. Dep. NTIS, PC A02/MF A01.

Low frequency, f < 500 kHz, turbulent density fluctuations have been observed in the ohmically heated plasma of the Proto-Cleo torsatron. The power density spectrum indicates a spectral decay of the form $f^{-2.5}$ with no coherent modes present in the observed band. Phase spectral characteristics indicate wave number estimates which vary in magnitude and direction consistent with drift wave phenomena. Parallel wave numbers are coupled proportionally to the shear.

FUSION POWER PLANT TECHNOLOGY

5165 (DOE/ET—0117/1) **General characteristics and assessment of the scientific/technical feasibility of the next major device in the tokamak fusion program. Summary of the US contributions to the INTOR workshop.** Stacey, W.M. Jr.; Gilleland, J.R.; Kulcinski, G.L.; Rutherford, P.H. (Department of Energy, Washington, DC (USA). Office of Energy Technology). Sep 1979. 18p. Dep. NTIS, PC A02/MF A01.

A substantial physics and technology data base for INTOR exists today, and this data base will be expanded over the next few years by currently planned programs. However, certain crucial information will not be developed by currently planned programs. Much of this missing information could be developed on the INTOR time scale by the expansion and/or acceleration of existing R and D programs and by the establishment of new R and D programs. On this basis, it is concluded that it is scientifically and technologically feasible to undertake the construction of an INTOR-like device to operate in the early 1990s, provided that the supporting R and D effort is expanded immediately to provide an adequate data base within the next few years in a few critical areas. Furthermore, it is

concluded that the construction of an INTOR-like device to operate in the early 1990s is the appropriate next major step in the development of fusion power.

5166 (GA-A—15644) **Design considerations for the fusion engineering test facility.** Sager, P.H. Jr. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 10p. (CONF-791102—19). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

To provide a point of departure for the ETF conceptual design, the ORNL TNS design was adopted. This device was designed as an ignited, D-T burning, long pulse, air core tokamak. It has a D-shaped plasma with a major radius of 5 m, a minor radius of 1.2 m, and an elongation ratio of 1.6. The fusion power is 1140 MW during burn, and with exothermic reactions a total thermal power of 1450 MW is produced in the first wall and shield. Some reactor components are described.

5167 (ORNL/TM—6732) **Mission statement for the Engineering Test Facility.** (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

This Mission Statement defines the ETF activity during its operating life. The results of those operations must provide the data, knowledge, experience, and confidence to continue to the next steps beyond ETF in making fusion power a viable energy option. The results from the ETF mission (operations are assumed to start early in the 1990's) are to bridge the gap between the base of magnetic fusion knowledge at the start of operations and that reqired to design the EPR/DEMO devices.

5168 (PPPL—1598) **US tokamak research.** Furth, H.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1979. Contract EY-76-C-02-3073. 15p. (CONF-790912—9). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

Current experiments on ISX-B, Alcator C, PDX, and PLT respectively address the four areas of principal concern in the development of a tokamak reactor: optimization of MHD-stability at high β-values; achievement of high n tau/sub E/; preservation of plasma purity; and development of effective techniques for achieving high plasma temperatures. The neutral-beam-heated ISX-B is the first tokamak device to have reached a β-level of approximately 3%, thus exploring - or even challenging - the theoretical MHD beta limit. Pellet fueling has also been demonstrated successfully. Alcator C, in its initial half-field operation, has obtained tau/sub E/ values exceeding 20 msec and has found a modified empirical scaling pattern. The Poloidal Divertor Experiment (PDX) has entered initial round-plasma operation at currents up to 500 kA. Low-power ion-cyclotron heating on PLT has given bulk-ion-temperature rises up to 600 eV and energetic efficiencies exceeding those of neutral-beam heating. Interactive energization of beam-injected ions has also been demonstrated.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 4508

5169 (COO—2431-2) **Thermal-hydraulic and neutronic considerations for designing a lithium-cooled tokamak blanket.** Chao, J.; Mikic, B.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1978. Contract EY-76-S-02-2431. 117p. Dep. NTIS, PC A06/MF A01.

A methodology for the design of lithium cooled blankets is developed. The thermal-hydraulics, neutronics and interactions between them are extensively investigated. In thermal hydraulics, two models illustrate the methodology used to obtain the acceptable ranges for a set of design parameters. The methodology can be used to identify the limiting constraints for a particular design. A complete neutronic scheme is set up for the calculations of the volumetric heating rate as a function of the distance from the first wall, the breeding ratio as a function of the amount of structural material in the blanket, and the radiation damage in terms of atom displacements and gas production rate. Different values of the volume percent of Type-316 stainless steel are assigned in four breeding zones to represent a nonuniformly distributed structural material which satisfies various thermal-hydraulic requirements. The role that the radiation damage plays in the overall design methodology is described. The product of the first wall lifetime and neutron loading is limited by the radiation damage which degrades the mechanical properties of the material.

5170 (WFPS-TME—78-103) **Thermal and hydraulic analysis of a cylindrical blanket module design for a tokamak reactor.** Lee, A.Y. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Oct 1978. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

Various existing blanket design concepts for a tokamak fusion reactor were evaluated and assessed. These included the demonstration power reactors of ORNL, GA and others. As a result of this study, a cylindrical, modularized blanket design concept was developed. The module is a double-walled, stainless steel 316 cylinder containing liquid lithium for tritium breeding and is cooled by pressurized helium. Steady state and transient thermal conditions under normal and some off-design conditions were analyzed and presented. At the steady state reference operating point the maximum structure temperature is 452°C at the maximum stressed location and is 495°C at the less stressed location. The coolant inlet pressure is 54.4 atm, the inlet temperature is 200°C and the exit temperature is 435°C. The coolant could be utilized with a helium/steam turbine power conversion system with a cycle thermal efficiency of 30.8%.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 4762, 5160

5171 (CONF-790971—1) **Bundle divertor for INTOR.** Sheffield, J. (comp.). (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

From INTOR meeting; Atlanta, GA, USA (12 Sep 1979).

Studies undertaken for INTOR indicate that for a remotely handled, ignited tokamak both conventional poloidal divertors as (PDX, Phase 1) and bundle divertors (ISX-B, Phase 1) will require improvement. Work has been underway for more than a year at ORNL in collaboration with Westinghouse on improving the bundle divertor concept. This report summarizes the work to date.

5172 (COO—4460-2) **Intense ion beam applications to magnetic confinement fusion.** Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies). 24 Sep 1979. Contract EG-77-S-02-4460. 62p. Dep. NTIS, PC A04/MF A01.

The ion ring experiment is described in relation to its trapping effectiveness of the ion ring. Continued research proposed for FY 80 is presented. The long-pulse experimental program is also described along with proposed future studies. (MOW)

5173 (GA-A—14903) **Transient and frequency analysis of multi-coil systems by means of generalized circuit elements and eigenvectors.** Peuron, U.A. (General Atomic Co., San Diego, CA (USA)). Apr 1978. Contract EY-76-C-03-0167-038. 39p. (CONF-790214—2). Dep. NTIS, PC A04/MF A01.

From 1979 winter power meeting; New York, NY, USA (4 Feb 1979).

A complex eigenvector method is presented which has been developed into a circuit analysis program suitable for transient and frequency analysis of multi-coil systems which may contain a large number of mutual inductances and stray capacitances. Relevant modeling problems are discussed. Systems of this type usually have a large eigenvalue spread. It is shown that conventional numerical integration methods for such stiff systems would require an excessive number of time steps. A generalized branch concept is created to reduce the effort required for programming and data specifications. It makes it possible to write a simplified matrix state equation by inspection in a simple numerical form which is completed by the program. Multi-input multi-output state variable feedback as well as non-linear and time dependent circuit parameters are within the capabilities of this method. The computer program has been used to evaluate the damping characteristics, natural frequencies and voltage distribution for the ohmic heating coil system of the Doublet III fusion research device under various transient and periodic excitation conditions.

5174 (UCID—18309) **Detection of a normal zone in the MFTF magnets.** Owen, E.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 39p. Dep. NTIS, PC A03/MF A01.

A method is described for the electrical detection of a normal zone in inductively coupled superconducting coils. Measurements are made with two kinds of bridges, mutual inductance bridges and self-inductance bridges. The bridge outputs are combined with other measured voltages to form a detector that can be realized with either analog circuits or a computer algorithm. The detection of a normal zone in a pair of coupled coils, each with taps, is discussed in detail. It is also shown that the method applies to a pair of coils when one has no taps and to a pair when one coil is superconducting and the other is not. The method is extended, in principle, to a number of coils. A description is given of a technique for balancing the bridges at near the operating currents of the coils.

5175 (UCRL—15112) **Structural analysis of the magnet system for Mirror Fusion Test Facility (MFTF). Addendum I.** Loss, K.R.; Wohlwend, J.W. (General Dynamics/Convair, San Diego, CA (USA)). Sep 1979. Contract W-7405-ENG-48. 31p. (CASD-LLL--78-003). Dep. NTIS, PC A03/MF A01.

The stress analysis refinement of the MFTF magnet system using GDSAP (General Dynamics Structural Analysis Program) and NASTRAN finite element computer models has been completed. The objective of this analysis was to calculate a more refined case and jacket stress distribution. The GDSAP model was refined in the minor radius area to yield a more detailed prediction of the stress distributions in critical areas identified by the previous analysis. Modifications in the case plate thickness (from 3.0 inches to 3.2 inches) and in the conductor pack load distribution and stiffness were included. The GDSAP model was converted to an identical NASTRAN model to determine the influence on stress results using higher order elements.

5176 (UCRL—82910) **Vent rate of superconducting magnets during quench in the Mirror Fusion Test Facility.** Slack, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 4p. (CONF-791102—29). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

When a superconducting magnet goes normal, resistive heating in the conductor evaporates surrounding LHe, which must be vented. The nature and speed at which the magnet goes normal and He is vented are not subject to rigorous analysis. This paper presents vent data from an existing magnet. An approximate mathematical model is derived and fitted to the data to permit scaling of vent requirements to larger size magnets. The worst case models of the vent employed in Mirror Fusion Test Facility (MFTF) cryogenic system design are also presented.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 4531, 5189

5177 (UCID—18318) **Pulse power for 0.3 to 0.5 μs durations.** Smith, I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

Conceptual design studies indicate that the KrF lasers which would drive inertial confinement fusion reactors will obtain their energy from multi-megajoule electron beams with pulse durations of perhaps three to five tenths of a microsecond. This paper discusses the following related topics: (1) pulse forming lines, (2) pulse charged PFN's, (3) Marx PFN, (4) Marx peaking circuit, and (5) other approaches. (MOW)

5178 (UCRL—82954) **Design and testing of low capacitance, 80-kV source cables for MFTF sustaining neutral beam power supplies.** Mayhall, D.J.; Shimer, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—28). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

In this paper we summarize characteristics of several cable configurations and consider one design in detail, which consists of twelve, 250 MCM arc cables, ten 4/0 filament cables, and accel, gradient grid, control, and instrumentation cables within a circular split Al pipe. The pipe is air insulated from an outer 24-in. x 24-in. steel duct by utility pin insulators. Varying run lengths require adjustment of the arc inductance by variation of cross sectional cable position. Equilibrium heat transfer analysis indicates the pulse-off time for source conditioning must be somewhat greater than 60 s to keep conductor temperatures below 90°C. The results of a high voltage test of a model cable are presented.

COOLING SYSTEMS

5179 (COO—2431-3) **Design window calculations for a constant q′ lithium blanket comparing lithium and sodium coolants.** Gierszewski, P.; Mikic, B.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1979. Contract EY-76-S-02-2431. 36p. NTIS, MF A01.

Portions of document are illegible.

In previous work, a design window approach has been applied to a liquid metal cooled, stagnant lithium breeding blanket, where the cooling tubes are spaced such that they all have the same heat flux per unit length (constant q′). This report is partly supplemental in that is is a detailed clarification of the equations and assumptions used, including several refinements. However, it also includes documentation for a revised version of the WINDOW code used to generate the design windows, and (as an example of the usefulness of the design window approach) a comparison of lithium cooling to sodium cooling of this blanket. The results confirm the desirability of lithium as a coolant.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 5178

5180 (GA-A—15639) **Three-dimensional heat transfer analysis of the Doublet III beamline calorimeter.** Kamperschroer, J.H.; Pipkins, J.F. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 7p. (CONF-791102—16). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A general three-dimensional analysis has been formulated to study the flow of heat in a neutral beam calorimeter. The boundary value problem with an arbitrary incident heat flux has been solved using Fourier analysis and Laplace transform techniques. A general solution has been obtained and subsequently studied using numerical techniques as applied to the particular geometry and incident heat flux conditions of the Doublet III injection system. Negligible errors result in unfolding the incident heat flux through the use of thermocouples located near the rear surface, if data taking is initiated at the proper time and proceeds at a sufficiently rapid rate.

5181 (LBL—8940) **Study of the general plasma characteristics of a high power multifilament ion source.** Schoenberg, K.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 139p. Dep. NTIS, PC A07/MF A01.

Thesis.

A general assessment of the steady state and time dependent plasma properties which characterize a high power multifilament ion source is presented. Steady state measurements, obtained via a pulsed electrostatic probe data acquisition system, are described. Fluctuation measurements, obtained via a broadband digital spectral analysis system, are also given.

5182 (PPPL—1606) **Active-passive waveguide array for wave excitation in plasmas.** Motley, R.W.; Hooke, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 13p. Dep. NTIS, PC A02/MF A01.

A modified version of the standard waveguide grill for exciting lower hybrid plasma waves is proposed. This version should reduce both the number of RF drive components and the amplitude of the (undesirable) surface waves. Results from a simple 2-element array are presented.

5183 (UCID—18322) **Hydrogen recycling in tandem mirror machines.** Simonen, T.C.; Drake, R.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1979. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

This paper describes hydrogen recycling in tandem mirror machines. In TMX, hydrogen (or deuterium) is introduced by the neutral beam injection system and by the solenoid gas feed system. Pumping is achieved by titanium gettering on liquid nitrogen panels. Mirror machine recycling differs from that in a tokamak. In mirrors, plasma losses are mainly to the large volume at the ends of the machine, remote from the hot plasma region. Similar techniques have been employed on 2XIIB. The design of the TMX vacuum system was described by Atkinson. MFTF also employs an integral beam line vacuum system. However, since in MFTF the pulse length is 0.5 sec, helium cryopanels are used to extend the pumping duration. Also special neutral beam and beam-ion dumps are employed.

5184 (UCRL—82818) **24-MW neutral-beam injector of 400-keV H^0.** Fink, J.H.; Hamilton, G.W.; Erickson, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—23). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The negative and positive ion systems have both common goals and common problems. In fact, we have identified five items that must be developed before any large, neutral-beam injector, operating continuously or almost so, can be engineered. The five items are: (1) a continuous or almost continuous ion source, with 1A designating a source of positive ions and 1B a direct extraction source of negatives, (2) a recirculating metal-vapor cell, (3) a computer code with which to calculate beam trajectories in three dimensions, (4) a resistive coating to bleed stray charges from the surface of high-voltage vacuum insulators, and (5) an arc suppression technique for large systems. These items are discussed and it is shown how their development is prerequisite to the design of a 24-MW, 400-keV neutral hydrogen injector such as might be required for a fusion power reactor.

5185 (UCRL—82877) **Testing of developmental neutral beam sources for MFTF.** Molvik, A.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—25). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The design of a four-grid, spherically-focused, 10-by-46-cm area accelerator and ion source for the Mirror Fusion Test Facility (MFTF) has been previously described. This source was designed to operate at 80 kV-80 A for 0.5 s, and along with a matching, three-

grid 20-kV-100-A-10-ms accelerator, has been built and tested. The 80-kV source has operated beyond design specifications to 90 kV-90 A for 12 ms. Pulse duration was limited by a capacitor bank accelerator power supply. Tests to 0.5 s on the High Voltage Test Stand (HVTS) are in progress. The major change found necessary during testing was the installation of a grounded shield to block neutralizer plasma from flowing into the region between high voltage and ground. The $D_1^+:D_2^+:D_3^+$ ratio was measured by Doppler shift spectroscopy and momentum analysis to be 0.68:0.20:0.12. Accelerator grids are built to a 7-m-radius spherical surface that aims individual beamlets at the center of curvature.

5186 (UCRL—82878) **Water-cooled U-tube grids for continuously operated neutral-beam injectors.** Hoffman, M.A.; Duffy, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—22). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A design for water-cooled extractor grids for long-pulse and continuously operated ion sources for neutral-beam injectors is described. The most serious design problem encountered is that of minimizing the thermal deformation (bowing) of these slender grid rails, which have typical overall spans of 150 mm and diameters on the order of 1 mm. A unique U-tube design is proposed that offers the possibility of keeping the thermal bowing down to about 0.05 mm (about 2.0 mils). However, the design requires high-velocity cooling water at a Reynolds number of about 3×10^4 and an inlet pressure on the order of 4.67×10^6 Pa (677 psia) in order to keep the axial and circumferential temperature differences small enough to achieve the desired small thermal bowing. It appears possible to fabricate and assemble these U-tube grids out of molybdenum with high precision and with a reasonably small number of brazes.

5187 (UCRL—82911) **Final design of the neutral beam lines for the Tokamak Fusion Test Reactor.** Pittenger, L.C.; Valby, L.E.; Stone, R.R.; Pedrotti, L.R.; Denhoy, B.; Yoard, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 11p. (CONF-791102—27). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Final design of the neutral beam lines for TFTR has been completed. A prototype has been assembled at Lawrence Berkeley Laboratory and is undergoing testing as part of the Neutral Beam System Test Facility (NBSTF). The final neutral beam line (NBL) configuration differs in several details from that previously reported upon; certain components have been added; and testing of the cryopump system has led to some design simplification. It is these developments which are reported herein.

5188 (UCRL—82974) **Engineering design of a 40 kV neutral-beam source.** Duffy, T.J.; Molvik, A.W.; Baird, E.D.; Correll, D.L.; Munger, R.H.; Gillespie, K.; Holland, E.D.; Pastrone, J.A.; Santamaria, G.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Maxwell Labs., Inc., San Diego, CA (USA)). 5 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—10). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Sections of the 40-kV, 40-A, TMX source are shown. This module is comprised of the arc chamber and accelerator sections. The source accelerator section uses a single rectangular insulator to perform three functions: providing voltage standoff, forming the supporting structure, and acting as the vacuum wall. Both machinable glass ceramic (Corning Macor/sup TM/) and F.R.P. (Nema G-10) have been used for this insulater. In either case, the insulator is joined to the titanium base plate and extractor electrode by thermal-setting-epoxy adhesive. The parts are self jigging; the bonding is done at 120 to 130 °C under a load of .34 MPa (50 psi).

5189 (UCRL—83216) **Start-up neutral-beam power supply system for MFTF.** Mooney, L.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—34). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper describes some of the design features and considerations of the MFTF start-up neutral-beam power supplies. In particular, we emphasize features of the system that will ensure MFTF compatibility and achieve the required reliability/availability for the MFTF to be successful.

POWER CONVERSION SYSTEMS

5190 (UCRL—82852) **Tests of high-power direct conversion on beams and plasma.** Barr, W.L.; Moir, R.W.; Hamilton, G.W.; Lietzke, A.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—31). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Two types of direct converters at up to 100 keV were tested. A beam direct converter was tested on a reduced area TFTR source at the Lawrence Berkeley Laboratory (LBL). After surface conditioning and outgassing, the efficiency was over 60% at the beginning of a pulse. During a pulse, the efficiency decreased as the gas density built up. A single-stage plasma direct converter with immersed grids is being tested on a steady-state ion beam with 6 kW of beam power. The power density at the grids can be varied by adjusting the beam focus. Recovery efficiencies over 70% are measured and we are now studying various loss mechanisms.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 4832, 4847, 5139, 5152, 5177

5191 (SAND—79-2133C) **Pulsed power particle beam fusion research.** Yonas, G. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. Dep. NTIS, PC A02/MF A01.

Although substantial progress has been made in the last few years in developing the technology of intense particle beam drivers, there are still several unanswered questions which will determine their ultimate feasibility as fusion ignition systems. The questions of efficiency, cost, and single pulse scalability appear to have been answered affirmatively but repetitive pulse technology is still in its infancy. The allowable relatively low pellet gains and high available beam energies should greatly ease questions of pellet implosion physics. Insofar as beam-target coupling is concerned, ion deposition is thought to be understood and our measurements of enhanced electron deposition agree with theory. With the development of plasma discharges for intense beam transport and concentration it appears that light ion beams will be the preferred approach for reactors.

5192 (UCID—18324) **Elimination of defects in plasma polymerized films used in laser fusion targets.** Letts, S.A.; Johnson, W.L.; Myers, D.W.; Illige, J.D.; Lorensen, L.E.; Hatcher, C.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1979. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

This study was conducted to understand and control the parameters governing the formation of defects in plasma polymerized surfaces. An inductively-coupled discharge was used as the source of activated monomer. Four types of well characterized surface irregularities were produced on glass slides which were subsequently fluorocarbon coated. Optimization of the process variables is discussed. (MOW)

5193 (UCRL—52830) **Development of a plasma retropulse shutter for Shiva and Nova.** Bradley, L.P.; Orham, E.L.; Stowers, I.F.; Koert, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Sep 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

A plasma shutter is being developed for a Nd:glass laser fusion system which, at an output spatial filter pinhole, produces a plasma of 10^{21} cm^{-3} to block target-reflected light from reentering the laser. A pulser using low-inductance capacitors and elastomer dielectric is switched with uv preilluminated railgaps to resistively heat a wire producing a plasma. The plasma generated within a nozzle and configured in a railgun geometry is projected across the optical beam path at 3.9 cm/μs. The optics are protected from the plasma. A scaled experiment is characterized, and a prototype shutter module is described.

5194 (UCRL—82928) **Mechanical design for a large fusion laser system.** Hurley, C.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 14p. (CONF-791102—11). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The Nova Mechanical Systems Group at LLL is responsible for the design, fabrication, and installation of all laser chain components, for the stable support structure that holds them, and for the beam lines that transport the laser beam to the target system. This paper is an overview of the group's engineering effort, emphasizing new developments.

5195 (UCRL—83372) **Laser-driven shockwave experiments at extreme high pressures.** More, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Sep 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

Laser-driven shockwave experiments have been proposed for accurate determination of equation of state data in the multimegabar pressure range. This paper gives a quantitative analysis of the prospects for such experiments. In order to unambiguously interpret shockwave data, one requires a clean shock -- that is, a planar, steady

shock wave entering cold material (without significant preheat perturbation). The problems of attaining sufficiently clean shocks at high pressure are examined and scaling relations which relate the pressure achieved to laser intensity, pulse energy, etc, are developed. It is shown that significantly higher pressures can be achieved when structured (layered) targets are used.

5196 (UCRL-Trans—11509) **Hydrodynamics of spherical targets with allowance for refraction of laser radiation.** Rozanov, V.B. (AN SSSR, Moscow. Fizicheskij Inst.). Sep 1979. Translation of Preprint No. 78, Quantum Radiophysics, P.N. Lebedev Physics Institute, Moscow, 1979. 12p. Dep. NTIS, PC A02/MF A01.

The present paper is devoted to the numerical simulation of laser experiments with spherical targets. To determine the energy absorbed, the equations of hydrodynamics with electron heat conduction and the Maxwell equations for laser radiation were solved using the density and temperature profiles obtained from hydrodynamic calculations. The flow is assumed spherically symmetric, and the laser beam is not necessarily focused at the center of the target.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

5197 (CONF-791102—12(Draft)) **Neutron shield analysis and design for the PDX fusion facility.** Grimesey, R.A.; Nigg, D.W.; Scott, A.J.; Wheeler, F.J.; Jassby, D.L.; Perry, E.D. (EG and G Idaho, Inc., Idaho Falls (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1979. Contract EY-76-C-07-1570. 19p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The basic component of the biological shield for PDX is an existing 81 cm thick high-density concrete shielding wall surrounding the machine. The principal additional shielding requirement is a roof shield over the machine to reduce air-scattered skyshine dose into the PDX control room and to the site boundary. The roof shield is designed in removable sections on a steel support structure permitting overhead crane access to major PDX components. After analysis of a number of alternate concepts, a roof shield consisting of 50 cm of water in polyethylene tanks was selected to meet design objectives of effectiveness, weight, removability, and cost.

5198 (COO—4861-1) **Prediction of the behavior of structural materials under irradiation through modeling of the microstructure. Progress report, April 1, 1978-August 30, 1979.** Wolfer, W.G. (Wisconsin Univ., Madison (USA)). Aug 1979. Contract ER-78-S-02-4861. 45p. Dep. NTIS, PC A03/MF A01.

The development of the radiation-induced microstructure occurs in several stages: formation of small defect clusters, formation of dislocation loops, nucleation and growth of voids, and regeneration of the dislocation network. With the exception of the latter, these processes can be modeled with rate equations of similar form. However, instead of using one rate equation for each defect cluster of a given size, the discrete formulation is transformed in a continuous one leading to Fokker-Planck equations. It is shown by comparing the steady-state nucleation rates of both formulations that the Fokker-Planck equation derived is the correct continuous description. A path-integral solution for the Fokker-Planck equation was derived to provide the basis for a numerical solution procedure, capable of dealing with the vastly different time scales involved in cluster formation, nucleation, and growth.

5199 (DOE/ER—0033) **Magnetic fusion energy and computers: the role of computing in magnetic fusion energy research and development.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). Oct 1979. 57p. Dep. NTIS, PC A04/MF A01.

This report examines the role of computing in the Department of Energy magnetic confinement fusion program. The present status of the MFECC and its associated network is described. The third part of this report examines the role of computer models in the main elements of the fusion program and discusses their dependence on the most advanced scientific computers. A review of requirements at the National MFE Computer Center was conducted in the spring of 1976. The results of this review led to the procurement of the CRAY 1, the most advanced scientific computer available, in the spring of 1978. The utilization of this computer in the MFE program has been very successful and is also described in the third part of the report. A new study of computer requirements for the MFE program was conducted during the spring of 1979 and the results of this analysis are presented in the forth part of this report.

5200 (GA-A—15305) **Design of tokamak reactors for maintainability.** Puhn, F.A.; Field, R.E. (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract EY-76-C-03-0167-038. 20p. (CONF-791102—32). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

With the advent of deuterium-tritium burning capability, the design of future tokamak reactors will be impacted by the requirement for remote maintenance. The maintenance philosophy must be defined early in the engineering phase of a new program, and suitable management techniques adopted to insure consistent implementation of the maintenance criteria in the detail design. General categories of maintenance tasks should be determined for each major system in the reactor. Detailed maintenance procedures should be developed for each system, and special tooling requirements should be identified. The various maintenance tasks and tooling should be proof-tested prior to their first operational use.

5201 (GA-A—15638) **Armor plate protection for the Doublet III vacuum vessel for neutral beam heating.** Colleraine, A.P.; Kamperschroer, J.H.; Pipkins, J.F. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 7p. (CONF-791102—17). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The design of vacuum vessel armor plate for neutral beam systems presents a number of challenges to the engineer. Heat fluxes of several hundred watts/cm^2 must be handled on a routine basis during normal plasma operations, and a factor of ten increase in these fluxes can occur during plasma disruptions. At the present time, a graphite tile system appears to be the best candidate for such a situation. Heat fluxes in excess of 4 kW/cm^2 can be routinely sustained and the material sputtered or evaporated from the surface has a low atomic number. The system proposed for Doublet III will provide valuable data for the designers of future fusion reactors and will also provide proof-of-principle demonstrations for such machines as TFTR and JET.

5202 (GA-A—15640) **Optical pyrometry applied to the neutral beam interlock system for Doublet III.** McMahon, T.R.; Kamperschroer, J.H.; Colleraine, A.P. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 6p. (CONF-791102—15). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The neutral beam injection system for Doublet III has been designed with curved grid ion sources and near-perpendicular injection. Given these conditions the neutral beam power loading on the inside wall of the vacuum chamber can be as high as 5 kW/cm^2 if no plasma is present. To protect the tokamak against the neutral beam under conditions where the plasma density is diminished, a fast infrared detector system is being developed. This device will monitor the beam hot spot on the armor plate and provide an interrupt signal when the temperature rises above a present value. The characteristics of a detector able to meet the desired performance specifications while operating in a tokamak environment are described.

5203 (HEDL-SA—1904-FP) **Shielding consideration for a deuteron activated liquid lithium system.** Huang, S.T.; Shapiro, A.M.; Lee, J.B.; Miller, W.C. (Parsons (Ralph M.) Co., Pasadena, CA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1979. Contract EY-76-C-14-2170. 4p. (CONF-791102—37). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A parametric study was conducted to evaluate the potential shielding implication due to the ^{7}Be plateout on the lithium piping in the FMIT facility. Various parameters such as plateout percentage, hot flush efficiency and ^{7}Be trapping efficiency were varied to assess the overall shielding requirement relationship. The ^{7}Be plateout was found to place severe limitations on the hands-on maintenance access. Hot flush and ^{7}Be traps are effective ways of minimizing the ^{7}Be plateout. To be effective in reducing local shielding requirements, the combined ^{7}Be trapping and hot flush efficiency shall be greater than 95%.

5204 (LA-UR—79-168) **Cross-section sensitivity and uncertainty analysis for fusion reactors (a review).** Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 25p. (CONF-781262—1). Dep. NTIS, PC A02/MF A01.

From IAEA nuclear data for fusion reactor technology meeting; Vienna, Austria (11 Dec 1978).

A review is presented of neutron cross-section sensitivity and uncertainty studies as applied to fusion reactor concepts. General observations are made concerning the applicability and potential value of such studies, as well as their current limitations. While literature is cited relative to sensitivities to D-D and D-T cross sections, as well as to temperature of the D-T reaction, these topics are excluded from discussion. After a brief review of cross-section and secondary-energy-distribution sensitivity theory, most emphasis is focused upon published studies of the TFTR, experimental power reactors, and a conceptual commercial reactor (NUWMAK). Salient results of these studies, as they pertain to cross-section measurement and evaluation requirements, are summarized. Lastly, some comments are made relative to cross-section data requirements in the 14 to 50 MeV region.

5205 (UCRL—82956) **Foundation system of the local control and instrumentation system for MFTF.** Lau, N.H.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 4p. (CONF-791102—24). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

There are over 50 distinguishable systems in the Local Control and Instrumentation System (LCIS) of the Mirror Fusion Test Facility. It became clear that as much as possible a common hardware system or foundation system should be used. This foundation system consists of three major subsystems, the LSI-11 computer, the fiber optic communication links, and the CAMAC system. The LSI-11 computer includes a 32 K word memory, a serial interface that communicates with the supervisor computer, and the serial driver, which provides serial CAMAC protocols and the block transfer function. The fiber optic links are duplex-links of optical transmitters, receivers, and fiber cables. These links carry information between the LSL-11 computer and the CAMAC system, which are more than 200 m apart.

5206 (UCRL—82958) **Supervisory Control and Diagnostics System Distributed Operating System.** McGoldrick, P.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—35). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper contains a description of the Supervisory Control and Diagnostics System (SCDS) Distributed Operating System. The SCDS consists of nine 32-bit minicomputers with shared memory. The system's main purpose is to control a large Mirror Fusion Test Facility (MFTF).

5207 (UCRL—82959) **Man-machine interface for the MFTF.** Speckert, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—36). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

In any complex system, the interesting problems occur at the interface of dissimilar subsystems. Control of the Mirror Fusion Test Facility (MFTF) begins with the US Congress, which controls the dollars, which control the people, who control the nine top-level minicomputers, which control the 65 microprocessors, which control the hardware that controls the physics experiment. There are many interesting boundaries across which control must pass, and the one that this paper addresses is the man-machine one. For the MFTF, the man-machine interface consists of a system of seven control consoles, each allowing one operator to communicate with one minicomputer. These consoles are arranged in a hierarchical manner, and both hardware and software were designed in a top-down fashion. This paper describes the requirements and the design of the console system as a whole, as well as the design and operation of the hardware and software of each console, and examines the possible form of a future man-machine interface.

5208 (UCRL—82960) **Software for the Local Control and Instrumentation System for MFTF.** Labiak, W.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—33). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

There are nine different systems requiring over fifty computers in the Local Control and Instrumentation System for the Mirror Fusion Test Facility. Each computer system consists of an LSI-11/2 processor with 32,000 words of memory, a serial driver that implements the CAMAC serial highway protocol. With this large number of systems it is important that as much software as possible be common to all systems. A serial communications system has been developed for data transfers between the LSI-11/2's and the supervisory computers. This system is based on the RS 232 C interface with modem control lines. Six modem control lines are used for hardware handshaking, which allows totally independent full duplex communications to occur. Odd parity on each byte and a 16-bit checksum are used to detect errors in transmission.

GENERAL AND MISCELLANEOUS

MANAGEMENT

5209 (DOE/AD—0033) **Supervisory, management, and executive bibliography.** (Department of Energy, Washington, DC (USA)). 1 Oct 1979. 34p. Dep. NTIS, PC A03/MF A01.

536 citations are listed in this bibliography. (RWR)

5210 (DOE/CR—2250/1) **Cost and schedule control systems criteria for contract performance measurement. Summary description.** (Department of Energy, Washington, DC (USA). Office of the Controller). Aug 1979. 26p. Dep. NTIS, PC A03/MF A01.

This document provides an overview of the Cost and Schedule Control Systems Criteria (CSCSC), and their operation and application on selected contracts within DOE projects. Detailed guidance for the implementation of these Criteria to specific contracts and for the review and acceptance of contractors' cost and schedule control systems for compliance therewith is contained in DOE/CR2250/2. Other guidance is provided in the following areas: the duties and responsibilities of participants in systems review activities and in the continued government surveillance of contractors' systems; contractor reporting of performance data to DOE and DOE analysis of these data; and the use of the Work Breakdown Structure technique.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 4956, 4962

5211 (DOE/TIC—10298) **ERATO4 and computing the smallest eigenvalue of the pencil A-λB.** Scott, D.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

Computation of the smallest eigenvalue (and eigenvector) of the generalized eigenvalue problem A-λB is addressed; the matrices A and B are real and symmetric, B is positive definite, and both are quite sparse. Previous methods of computation used the inverse power method; this approach requires large amounts of computer storage. Alternative calculation methods were investigated with varying degrees of success and practicality. The ERATO code uses the inverse power method, but stores arrays in such a way as to minimize storage requirements. Use of this code greatly eased the execution of MHD calculations on the CRAY computer. (RWR)

5212 (GEPP—397) **Simple microcomputer interface to instruments with parallel decimal (BCD) outputs.** Ridgeway, P.E. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1979. Contract EY-76-C-04-0656. 7p. Dep. NTIS, PC A02/MF A01.

A simple interface to couple a microcomputer to almost any parallel BCD output device using the 8255 Programmable Peripheral Interface I.C. is described. A typical connection is shown, and a flow chart and program illustrate the software required. 3 figures. (RWR)

5213 (LA—8072-MS) **Report of the LTSS performance measurement project.** Keller, T.W. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

A performance measurement study of the Livermore Time Sharing System (LTSS) operating system at the Los Alamos Scientific Laboratory was undertaken to determine the level of performance of the system and recommend means of raising that level, if possible. This report describes the projects and its conclusions. 4 figures, 9 tables.

5214 (ORNL/CSD—49) **Solving sparse symmetric generalized eigenvalue problems without factorization.** Scott, D.S. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

An iterative technique is discussed for finding the algebraically smallest (or largest) eigenvalue of the generalized eigenvalue problem $A - \lambda M$, where A and M are real and symmetric, and M is positive definite. It is assumed that A and M are such that it is undesirable to factor the matrix $A - \sigma M$ for any value of σ. It is proved that the algorithm is globally convergent and that convergence is asymptotically quadratic. Finally, the modifications required in the algorithm to make it computationally feasible are discussed. 7 tables.

5215 (SAND—79-1587) **Global error estimation for stiff ODEs.** Shampine, L.F. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

A method is presented which, in some generality, provides a rough estimate of the global error arising in the numerical solution of the initial-value problem for a stiff set of ordinary differential equations (ODEs). The procedure is not rigorously correct like global extrapolation, nor is its justification comparable to that of Stetter's scheme for Adams codes. There is a close relationship between the method and more specialized ones proposed by Robinson and Prothero [Conference on Numerical Analysis, Univ. of Dundee, Scotland, 1977] and Dew and West [BIT, 19, 135-137(1979). A careful discussion of the most important approximations made in the present paper

illuminates the accuracy and reliability of these other methods. (RWR)

5216 (SAND—79-1827) **Department 5640 quarterly report: Applied Mathematics, April-July 1979.** (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Brief reports (extended abstract length) of work during the period are given; only enough technical detail is provided to give an appreciation of the substance of the work reported. Full descriptions are given in other technical reports and papers. The following topics are included: software/numerical analysis, discrete mathematics, classical applied mathematics, and systems analysis. Lists of presentations and publications are also given. (RWR)

5217 (UCID—30135(Rev.2)) **FUNPACK user's guide.** Lozares, I.S.; Fritsch, F.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1979. Contract W-7405-ENG-48. 104p. Dep. NTIS, PC A06/MF A01.

FUNPACK is a collection of certified software for the evaluation of special functions. Routines are available for computing exponential integrals, complete elliptic integrals of the first and second kind, Dawson's integral, the modified Bessel functions of the first and second kind of order zero and order one, the Bessel functions of the first kind of order zero and order one, the Bessel function of the second kind of nonnegative real order, and the logarithmic derivative of the Gamma function.

5218 (UCID—30171) **GRAFCORE-reference manual. Implementation of the SIGGRAPH standard's proposal.** Rowe, J.H.; Keller, P.; O'Hair, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Sep 1979. Contract W-7405-ENG-48. 296p. Dep. NTIS, PC A13/MF A01.

The aim of the GRAFLIB effort is to provide a comprehensive, integrated system of graphics subroutines for use in all computer graphics found in the LLL computing community. At its most fundamental level is a fast, small system of core routines (GRAFCORE), in which each routine performs a very elementary function. These routines may be used directly for the graphics in codes where efficiency is critical. All higher level GRAFLIB routines are built on top of GRAFCORE. The GRAFCORE-user interface is machine-independent, the actual routines may be machine-dependent. This report presents a detailed explanation of all aspects of GRAFCORE. 12 figures, 17 tables. (RWR)

5219 (UCID—30172) **GRAFLIB: reference manual.** Keller, P.; O'Hair, K.; Rowe, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Oct 1979. Contract W-7405-ENG-48. 192p. Dep. NTIS, PC A09/MF A01.

GRAFLIB is a library of graphics functions for use in FORTRAN programs. It is machine-independent, and all plotting functions are independent of the particular device that is active. Included in GRAFLIB are functions that do basic line-drawing, text plotting (in many fonts), curve plotting, two-dimensional shading, two-dimensional contouring, and many others. Any function written by a user that satisfies the GRAFLIB standard may also be added to the library. GRAFLIB level is directed to the typical graphics user. The aim of the GRAFLIB effort is to provide a comprehansive, integrated system of graphics subroutines for use in computer graphics. GRAFLIB is founded on the proposition that a graphics need arising in any kind of situation should be answerable with software tools appropriate to that situation. At its most fundamental level is a fast, small system of core routines (GRAFCORE), in which each routine performs a very elementary function. These routines may be used directly for the graphics in codes where efficiency is critical. All higher level GRAFLIB routines are built on top of GRAFCORE. At an intermediate level GRAFLIB provides an assortment of routines for needs that arise in the most common graphics applications. Versatility characterizes this level. At its highest level of usage, GRAFLIB offers a gallery of canned formats and canned routines for entire specific applications. One call to a canned subroutine, for instance, may draw an entire graph, complete with grid and axis numbering, fancy title and labels, and the input coordinate data plotted as a curve. In terms of speed and performance GRAFLIB represents a substantial improvement over current graphics utilities. Versions of the new library have been installed on the 7600's, the STAR's, and the CRAY. 9 figures. (RWR)

5220 (UCRL—52823) **SLIC: an interactive, graphic mesh generator for finite-element and finite-difference application programs.** Gerhard, M.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Sep 1979. Contract W-7405-ENG-48. 93p. Dep. NTIS, PC A05/MF A01.

SLIC was designed to automate the mesh generation procedure by relieving the engineer of much of the computational effort. Only a few key points (to describe the model geometry adequately) need be input with discrete coordinates. Elements are constructed after their corresponding nodes have been generated and verified. Improvements over earlier codes include the following: interactive or batch input or a combination, interactive error recovery, compressed data storage, stacking of input commands, selection of analysis code input file structures, interactive HELP package, alphabetic keyword input options, free-form input, error-corrected condensed RERUN command file, interactive NEWS package, and interactive real-time graphics display with option of creating a file for hard copy. This manual includes the following sections: introduction, conventions used in this manual, running SLIC, important comments and SLIC facts, handling errors, fundamental commands, 1-D generation commands, 2-D generation commands, 3-D generation commands, node numbering commands, sliding interfaces, information commands, control commands, display commands, special commands (boundary conditions, mesh enhancement, miscellaneous), and user subroutines. Appendixes containing a sample SLIC session, a sample user subroutine, command syntax, and an error summary are also provided. 17 figures. (RWR)

CIVILIAN DEFENSE

5221 (AD-A—063957) **An improvement to the WSEG fallout model low yield prediction capability. Master's thesis.** Ruotanen, N.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 103p. NTIS PC A06/MF A01.

The analysis of residual radiation from the detonation of nuclear weapons has resulted in a number of nuclear fallout prediction models. The most widely used of these is the WSEG (Weapons System Evaluation Group) fallout model which is a series of empirically based analytical algorithms. This study modifies three of the empirical parameters which control the transport and deposition of the fallout for the WSEG model. These three are the height of the center of the nuclear cloud, the cloud's vertical thickness, and the cloud's horizontal radius. In the original model, these parameters were empirical fits to data from four of the early nuclear test shots. This study updates the parameters by using more recent and thorough experimental data and by using information from the Department of Defense Fallout Prediction System (DELFIC Computer Model).

5222 (AD-A—064095) **The effects of wind variability of nuclear fallout doses. Final report.** Wittwer, L.A. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Aug 1978. 47p. NTIS PC A03/MF A01.

The effects of wind variability on nuclear fallout integrated doses is examined using recently developed Monte Carlo algorithms to generate sample three dimensional wind fields over the continental United States. Two scenarios are presented. The first is an intense attack on a proposed Advance Minuteman (MX) site near Yuma AZ. The second scenario is a lighter attack on the six Minuteman ICBM missile fields.

5223 (AD-A—064144) **Behavioral aspects of fallout shelter stay. Interim report, 16 November 1977-26 May 1978.** Levit, R.A. (BDM Corp., Vienna, VA (USA)). 26 May 1978. Contract DNA001-78-C-0060. 64p. NTIS PC A04/MF A01.

A major assumption underlying the calculation of casualties from a nuclear exchange concerns the time civilian populations can be expected to stay in fallout shelters. Presently, two general guidelines are used: (1) one week of shelter stay followed by two weeks of partial shelter occupancy and, (2) a two day shelter stay followed by three days of partial shelter occupancy. The objective of this program is to explore the nature of these assumptions using behavioral sciences data. Systematic quantitative estimates of shelter stay times can be obtained from an empirical data base. Length of shelter stay is dependent on a variety of variables the most important being degree of preparedness. Generally, post attack behavior will be the range considered normal. The use of quantitative estimates of fallout shelter stay time reduces the variability associated with predicting the human factor in strategic simulations.

5224 (AD-A—064149) **Theoretical air blast loading estimates on the M-X shelter, the influence of dust, and a recommended experimental program. Final report, 8 November 1976-31 March 1978.** Chambers, B.S. III; Hove, D.T.; Issa, R.I. (Science Applications, Inc., McLean, VA (USA)). 30 Jun 1978. Contract DNA001-77-C-0059. 143p. NTIS PC A07/MF A01.

This report discusses three activities performed in support of the M-X concept validation program, each specifically addressing various aspects of air blast loading on the M-X above-ground shelter concept. The three activities were (1) estimation of air blast loads on the M-X shelter; (2) modeling the pre- and post-shock dust lofting for air blast calculations; and (3) shock tube test planning for air blast loads measurements on a small scale model of M-X shelter. The first activity involved the generation of engineering estimates of the air blast loading on two orientations (end-on and side-on) of the M-X shelter for ultimate use by others for setting up structural response code calculations. Both ideal and precursed waveforms were considered. The second activity involved a review of the nuclear data base

to identify data useful to understanding the relative importance of lofted dust in the flow on air blast loading. Also theoretical models used for late-time dust lofting were reviewed to determine their utility of the air blast problem. A recommended model was developed for future inclusion into a hydrodynamic code, HULL. The third activity involved a review of shock tubes in the United States that would be appropriate for use in measuring the air blast loads on a small model of the M-X shelter. The CERF shock tube was chosen and an experimental program was planned.

5225 (AD-A—064316) **Blast/fire interactions. Program information. Final report, May-October 1978.** Martin, S.B.; Alger, R.S. (SRI International, Menlo Park, CA (USA)). Oct 1978. Contract DCPA01-78-C-0225. 181p. NTIS PC A09/MF A01.

This report is based on material generated during a DCPA-sponsored conference on blast-fire interactions held May 21-24, 1978 at Asilomar, California. The conference was convened to allow a selected group of authorities on fire, air blast, structural response, and related technologies to rethink the blast-fire effects of nuclear explosions on urban areas, to identify technical deficiencies in the current state of the predictive modeling art, and to plan a feasible research program to be accomplished within a reasonable time and budget.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Aerochem Research Labs., Inc., Princeton, NJ (USA)
Development of a model and computer code to describe solar grade silicon production processes. Fifth quarterly report, 5:4175 (DOE/JPL/954862—5)
Development of a model and computer code to describe solar grade silicon production processes, 5:4176 (DOE/JPL/954862—6)

Aerodyne Research, Inc., Bedford, MA (USA)
An assessment of the potential impact of combustion research on internal combustion engine emissions and fuel consumption. Final report, Dec 77-Apr 78, 5:4728 (PB—290953)

Aeronautical Research Labs., Melbourne (Australia)
Mechanisms of hydrogen embrittlement - crack growth in a low-alloy ultra-high-strength steel under cyclic and sustained stresses in gaseous hydrogen. Materials report, 5:4754 (AD-A—062571)

Aerospace Corp., El Segundo, CA (USA)
Feasibility of installing sulfur dioxide scrubbers on stationary sources in the south coast air basin of California. Volume II: technical discussion. Final report, 5:4482 (PB—290437)

Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.
Evaluation of liquid-gas separator materials for a silver-zinc cell vent. Final report, 5:4547 (AD-A—067210)

Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.
Design and performance of flowing-gas electrical-discharge CO_2 lasers. Interim report, 5:4823 (AD-A—063919)

AiResearch Mfg. Co., Torrance, CA (USA)
High-temperature ceramic heat exchanger. Final report, 5:4472 (EPRI-FP—1127)

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Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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26802	5:5099	Dep. NTIS, PC A02/MF A01
50983	5:3986	Dep. NTIS, PC A05/MF A01
50992	5:3958	Dep. NTIS, PC A03/MF A01
51031	5:4912	Dep. NTIS, PC A05/MF A01
BNL-NCS-26844	5:5089	Dep. NTIS, PC A02/MF A01
BNL-NUREG-51045	5:4887	*See* NUREG/CR-0936
CASD-LLL-78-003	5:5175	*See* UCRL-15112
CONF-770818-	(Conference on heat and mass transfer in buildings, Dubrovnik, Yugoslavia, 29 Aug-3 Sep 1977)	
P1	5:4622	The Publisher, 1025 Vermon Avenue, NW, Washington, DC 20005
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CONF-771242-	(9. conference of the Institute of Public Utilities, Williamsburg, VA, USA, 12-14 Dec 1977)	
	5:4557	East Lansing, MI; Michigan State University (1978).
CONF-780170-	(Workshop on appropriate technology, Harpers Ferry, WV, USA, 23-25 Jan 1978)	
	5:4598	*See* NSF/RA-790002
CONF-7804126-	(Middle East solar technology exhibition and conference, Bahrain, Bahrain, 24-27 Apr 1978)	
	5:4142	UK-ISES, 19 Albemarle St., London W1X 3HA, England
CONF-780883-	(Workshop on study of post Hartree-Fock: configuration interaction, Berkeley, CA, USA, 14-16 Aug 1978)	
	5:5047	*See* LBL-8233
	5:5062	*See* LBL-8233
	5:5063	*See* LBL-8233
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	5:5065	*See* LBL-8233
	5:5066	*See* LBL-8233
	5:5067	*See* LBL-8233
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CONF-780895-	(NCASI Southern regional meeting, Atlanta, GA, USA, 2-3 Aug 1978)	
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CONF-780983-	(3. solar heating and cooling R and D branch contractors' meeting, Washington, DC, USA, 24-27 Sep 1978)	
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CONF-7809180-		(2. congress of the Federation of Acoustical Societies of Europe, Warsaw, Poland, Sep 1978)
1	5:4016	Morgantown, WV; West Virginia University (1978).
CONF-781022-		(Meeting on nuclear power reactor safety, Brussels, Belgium, 16-19 Oct 1978)
128	5:4523	*See* HEDL-SA-1665
CONF-7810193-		(Annual meeting DKV: cryogenics and air conditioning in maritime regions, Hamburg, F.R. Germany, 11-14 Oct 1978)
2	5:4611	*See* INKA-Conf-78-276-005
CONF-7811133-		(Symposium on the tools, techniques and training for altering and repairing pressurized pipe systems, Chicago, IL, USA, 13-15 Nov 1978)
	5:4036	$25.00
CONF-7811140-		(Symposium on genes, cells and behavior: a view of biology fifty years later, Pasadena, CA, USA, 1-3 Nov 1978)
1	5:4969	*See* BNL-26596
CONF-781231-		(3. annual thermal energy storage contractor's information exchange meeting, Springfield, VA, USA, 5-6 Dec 1978)
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CONF-781262-		(IAEA nuclear data for fusion reactor technology meeting, Vienna, Austria, 11-15 Dec 1978)
1	5:5204	*See* LA-UR-79-168
CONF-790121-		(DOE/solar export opportunities workshop, Atlanta, GA, USA, 8-9 Jan 1979)
	5:4139	*See* SERI/TP-49-186
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CONF-790214-		(1979 winter power meeting, New York, NY, USA, 4-9 Feb 1979)
2	5:5173	*See* GA-A-14903
CONF-790348-		(Conference on the p,n reaction and the nucleon-nucleon force, Telluride, CO, USA, 29-31 Mar 1979)
6	5:5118	*See* UCRL-82587

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CONF-790364-		(Nonradial and nonlinear stellar pulsation workshop, Tucson, AZ, USA, 12-16 Mar 1979)
4	5:5026	*See* LA-UR-79-2785
CONF-790394-		(Cogeneration and North Carolina, Raleigh, NC, USA, 7-8 Mar 1979)
	5:4568	Dep. NTIS, PC A04/MF A01
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CONF-790449-		(EPA fuel conversion symposium, Hollywood, FL, USA, 17-20 Apr 1979)
2(Rev.)	5:3971	The Publisher, 3424 S. State St., Chicago, IL 60616
CONF-7904113-		(Expert meeting on chances and limits of heat pumps in practical use, Dortmund, F.R. Germany, 25-27 Apr 1979)
1	5:4614	*See* INKA-Conf-79-026-004
2	5:4615	*See* INKA-Conf-79-026-005
3	5:4613	*See* INKA-Conf-79-026-003
4	5:4612	*See* INKA-Conf-79-026-002
5	5:4616	*See* INKA-Conf-79-026-006
CONF-790541-		(International Solar Energy Society meeting, Atlanta, GA, USA, 28 May 1979)
57	5:4400	*See* UCRL-82367
58	5:4148	*See* LBL-9412
CONF-790571-		(6. national conference on energy and the environment, Pittsburgh, PA, USA, 21-24 May 1979)
5	5:3969	The Publisher, 3424 S. State St., Chicago, IL 60616
6	5:3970	The Publisher, 3424 S. State St., Chicago, IL 60616
CONF-790598-		(Institute of gas technology symposium: advances in coal utilization technology, Clarksville, IN, USA, 14-18 May 1979)
4	5:3985	The Publisher, 3424 S. State St, Chicago, IL 60616
CONF-7905117-		(Conference on power demand and supply - analysis and strategies, Schliersee, F.R. Germany, 16-17 May 1979)
4	5:4608	*See* INKA-Conf-79-095-001
CONF-7905118-		(Seminar on steam and gas turbines II: solar systems with gas turbines, Karlsruhe, F.R. Germany, 22 May 1979)
1	5:4217	*See* INKA-Conf-79-102-001
CONF-7905120-		(New Mexico Bureau of Mines and Mineral Resources conference, Albuquerque, NM, USA, 13-16 May 1979)
1	5:4060	*See* SAND-78-2345C
CONF-790606-		(20. US symposium on rock mechanics, Austin, TX, USA, 3-6 Jun 1979)
9	5:4046	Dep. NTIS, PC A02/MF A01
CONF-7906137-		(Lecture meeting on optimized energy economy in industry, Essen, F.R. Germany, 5 Jun 1979)
1	5:4695	*See* INKA-Conf-79-171-002
CONF-790709-		(VII international AIRAPT conference, La Creusot, France, 30 Jul-3 Aug 1979)
4(Rev.2)	5:4808	*See* UCRL-82296(Rev.2)
CONF-790728-		(24. annual meeting of the Health Physics Society, Philadelphia, PA, USA, 7-13 Jul 1979)
5	5:5122	Dep. NTIS, PC A02/MF A01
CONF-790750-		(NATP advance study institute on genome organ. and exp. in higher plants, Edinburgh, UK, 11-21 Jul 1979)
1	5:4968	*See* BNL-26438
CONF-790764-		(Conference on models of biological growth and spread, Heidelberg, F.R. Germany, Jul 1979)
1	5:4955	*See* LA-UR-79-2557
CONF-790766-		(International workshop on membrane bioenergetics, Detroit, MI, USA, 5-7 Jul 1979)
1	5:4978	*See* LBL-9673
CONF-790803-		(14. intersociety energy conversion conference, Boston, MA, USA, 5-10 Aug 1979)
57	5:3973	Chicago, IL; Institute of Gas Technology (1979).
58	5:4712	Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616
61	5:4131	Chicago, IL; Institute of Gas Technology (1979).
63	5:4042	*See* UCRL-82482
CONF-790822-		(87. AICHE national meeting, Boston, MA, USA, 19 Aug 1979)
15	5:3963	Chicago, IL; Institute of Gas Technology (1979).
CONF-790847-		(International conference on high energy physics and nuclear structure, Vancouver, Canada, 13-17 Aug 1979)
12	5:5080	*See* TRI-PP-79-27
CONF-790853-		(ONR workshop on electron generators of coherent radiation, Telluride, CO, USA, 13-17 Aug 1979)
3	5:4830	*See* BNL-26737
CONF-790862-		(3. international conference on phonon scattering in condensed matter, Providence, RI, USA, 28-31 Aug 1979)
4	5:5125	*See* BNL-26769
CONF-790880-		(Workshop on short term tests for chemical carcinogens, Vancouver, Canada, 22-24 Aug 1979)
1	5:4991	Dep. NTIS, PC A02/MF A01
CONF-790885-		(9. international symposium on lepton and photon interactions at high energy, Batavia, IL, USA, 23-29 Aug 1979)
2	5:5083	*See* ANL-HEP-CP-79-21
3	5:5075	*See* LBL-9912
4	5:5076	*See* LBL-9919
CONF-790887-		(Gas Research Institute symposium on methane detection and measurements, Chicago, IL, USA, 27 Aug 1979)
1	5:4037	*See* UCRL-83317
CONF-790889-		(Workshop on physics with fast molecularion beams, Argonne, IL, USA, 20-21 Aug 1979)
1	5:5053	*See* BNL-26759
CONF-790910-		(Symposium on calculation of phase diagrams and thermochemistry, Milwaukee, WI, USA, 17-19 Sep 1979)
2	5:4748	*See* BNL-26264
5	5:4739	*See* DP-MS-79-22
CONF-790912-		(9. European conference on controlled fusion and plasma physics, Oxford, UK, 17-21 Sep 1979)
9	5:5168	*See* PPPL-1598
CONF-790917-		(American Chemical Society national meeting, Washington, DC, USA, 10-14 Sep 1979)
13	5:3974	Chicago, IL; Institute of Gas Technology (1979).
14	5:3961	Chicago, IL; Institute of Gas Technology (1979).
CONF-790927-		(Linear accelerator conference, Montauk, NY, USA, 10-14 Sep 1979)
26	5:4851	*See* BNL-26733
27	5:4850	*See* BNL-26732
CONF-790956-		(Conference on non-traditional approaches to the study of the solid-electrolyte interface, Snowmass, CO, USA, 23-27 Sep 1979)
2	5:4759	*See* SAND-79-0549C
CONF-790965-		(10. international hot atom chemistry symposium, Loughborough, UK, Sep 1979)
1	5:4793	*See* COO-1713-78
2	5:4794	*See* COO-1713-79
CONF-790968-		(6. international conference on atomic masses, East Lansing, MI, USA, 18-21 Sep 1979)
4	5:5099	*See* BNL-26802
CONF-790971-		(INTOR meeting, Atlanta, GA, USA, 12-14 Sep 1979)
1	5:5171	Dep. NTIS, PC A03/MF A01
CONF-790975-		(CPIA-JANNAF combustion conference, Monterey, CA, USA, 10-14 Sep 1979)
3	5:4866	*See* LA-UR-79-2768

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CONF-790989-		(Supergravity workshop, Stony Brook, NY, USA, 26-29 Sep 1979)
1	5:5086	*See* LA-UR-79-2829
CONF-791002-		(19. annual Hanford life sciences symposium, Richland, WA, USA, 22-24 Oct 1979)
1	5:5006	*See* LA-UR-79-2737
CONF-791024-		(Solar industrial process heat conference, San Francisco, CA, USA, 31 Oct-2 Nov 1979)
4	5:4325	*See* LA-UR-79-2812
5	5:4221	*See* SAND-79-8777
CONF-791048-		(The Combustion Institute Western States Section meeting, Berkeley, CA, USA, 15-16 Oct 1979)
4	5:4715	*See* SAND-79-8715
CONF-791049-		(23. conference on analytical chemistry in energy technology, Gatlinburg, TN, USA, 9-11 Oct 1979)
2	5:4932	*See* UCRL-82789
11	5:4862	*See* DPSPU-79-30-14
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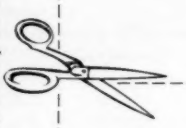

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